The role of facial cues to body size on attractiveness and perceived leadership ability

Daniel E. Re

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Declarations

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I, Daniel Edward Re, hereby certify that this thesis, which is approximately 51,000 words in length, has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

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Collaboration Statement

Throughout the experimental chapters (Chapters 4-9) in this body of work, the use of the personal pronoun “we” reflects the collaborative nature of experiments conducted in the Perception Lab. The use of “I” would betray the joint effort in running studies, however the design, analysis and discussion of experiments as detailed in the presented work is my own under the support of my supervisors.

This thesis is partly based on works submitted to and accepted for publication in peer-reviewed academic journals. These articles are identified at the beginning of each chapter in which they are featured. Co-authors are listed when they contributed intellectually to the presented work. Dr Vinet Coetzee and Dr Lynda Boothroyd helped collected and produce the 3D stimuli used in Chapter 5. Dr Dengke Xiao and Dr Bernard Tiddeman created the computer programmes used to display facial stimuli and record observers’ perceptual preferences (Chapter 7). Dr David Hunter created the computer program that allowed me to produce morphological masculinity scores in Chapter 7. Milena Dzhelyova and Iris Holzleitner helped collect the data presented in Chpater 8, and Cara Tigue and Dr David Feinberg helped collect and produce the stimuli. Dr Lisa DeBruine and Dr Ben Jones helped collect and produce the stimuli in Chpaters 7 and 9.

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Abstract

Facial appearance has a strong effect on leadership selection. Ratings of perceived leadership ability from facial images have a pronounced influence on leadership selection in politics, from low-level municipal elections to the federal elections of the most powerful countries in the world. Furthermore, ratings of leadership ability from facial images of business leaders correlate with leadership performance as measured by profits earned.

Two elements of facial appearance that have reliable effects of perceived leadership ability are perceived dominance and attractiveness. These cues have been predictive of leadership choices, both experimentally and in the real-world. Chapters 1 and 2 review research on face components that affect perceived dominance and attractiveness. Chapter 3 discusses how perceived dominance and attractiveness influence perception of leadership ability.

Two characteristics that affect both perceived dominance and attractiveness are height and weight. Chapters 4-9 present empirical studies on two recently-discovered facial parameters: perceived height (how tall someone appears from their face) and facial adiposity (a reliable proxy of body mass index that influences perceived weight). Chapters 4 and 5 demonstrate that these facial parameters alter facial attractiveness. Chapters 6, 7, and 8 examine how perceived height and facial adiposity influence perceived leadership ability. Chapter 9 examines how perceived height alters leadership perception in war and peace contexts. Chapter 10 summarises the empirical research reported in the thesis and draws conclusions from the findings. Chapter 10 also lists proposals for future research that could further enhance our knowledge of how facial cues to perceived body size influence democratic leadership selection.

Overview to Introductory Chapters

This thesis will focus on how facial cues to perceived body height and weight influence judgments of leadership ability. The introductory chapters discuss relevant literature on facial attractiveness, facial cues to physical dominance and body size, and facial cues to leadership judgments, including the roles of perceived attractiveness and dominance.

Chapter 1 examines facial cues to physical body size and strength. This chapter will discuss facial cues to physical dominance and how they influence human interaction. Chapter 1 will also detail relevant literature on reliable facial cues to physical strength and size, including recent literature on facial cues to height and weight.

Chapter 2 summarises relevant literature on facial attractiveness, including research on facial averageness, symmetry, skin condition and sexual dimorphism. Facial attractiveness has an effect on leadership choice, as described in Chapter 3.

Chapter 3 focuses on relevant research on facial cues to physical attractiveness. I divide this chapter into two sections – how attractiveness influences leadership choice, and how perceived dominance influences leadership choice. Chapter 3 is crucial in understanding the background of my experimental chapters. The studies described here form the basis on which much of my empirical work grounded, and Chapters 4-9 will cite many studies described in Chapter 3.

Chapter 1: Facial cues to physical dominance and body size

1. Physical dominance

Physical dominance has had a great impact on human social interaction throughout history (Puts, 2010). Much like in many mammalian species (Andersson, 1994; Darwin, 1871), size and strength are used to impose one's will in physical competition between humans. Traumatic injuries found in ancient skeletons (such as skull fractures) suggest that physical conflict was highly prevalent in our ancestral environment, likely leading to a large proportion of mortalities and possibly shaping human social behaviour (Bowles, 2009; Walker, 2001). Large physical size has a tremendous impact on human physical competition. Gaulin and Sailer (1984) calculated that the force of a blow in primates (for example, a punch in humans) increases as a cubic function of mass while the ability to resist a blow increases at most as a square function due to the cross-sectional width of bone. Larger primates are therefore able to inflict disproportionately more damage than smaller conspecifics. In humans, physical size and strength correlate with the instances of physical aggression and confrontation (Archer & Thanzami, 2007; Felson, 1996; Tremblay et al., 1998). The mental association between size and dominance exists in humans as early as 10-13 months, as infants of this age show more surprise (i.e., longer fixation) when longer lines back away from shorter lines than vice versa in simulated "confrontations" (Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011).

1.1 Facial cues to dominance

Given the role that aggressive competition has played throughout history, it would have been beneficial for humans to be able to quickly and accurately process a potential rival's physical size and strength. Consistent with this proposal, many studies have demonstrated that physical dominance is a trait that can be perceived from human faces. Digital techniques have allowed face researchers to "masculinize" faces by taking the morphological difference between an average male face and average female face, then enhancing the male characteristics of a particular face (this is referred to as a "masculinity transform"; see Figure 1.1). Masculinizing human faces increases how dominant male and female faces look, while making a face more feminine decreases perceived dominance (Boothroyd, Jones, Burt, & Perrett, 2007; DeBruine et al., 2006; Jones, DeBruine, et al., 2010; Main, Jones, DeBruine, & Little, 2009; Perrett et al., 1998). These findings are consistent with research demonstrating that masculinization of other body characteristics also increases perceived dominance, including lowering voice pitch (Feinberg et al., 2006; Puts, Gaulin, & Verdolini, 2006; Tusing & Dillard, 2000) and increasing body musculature (Frederick & Haselton, 2007). The effects of masculinity transforms on facial attractiveness will be discussed in Chapter 2.

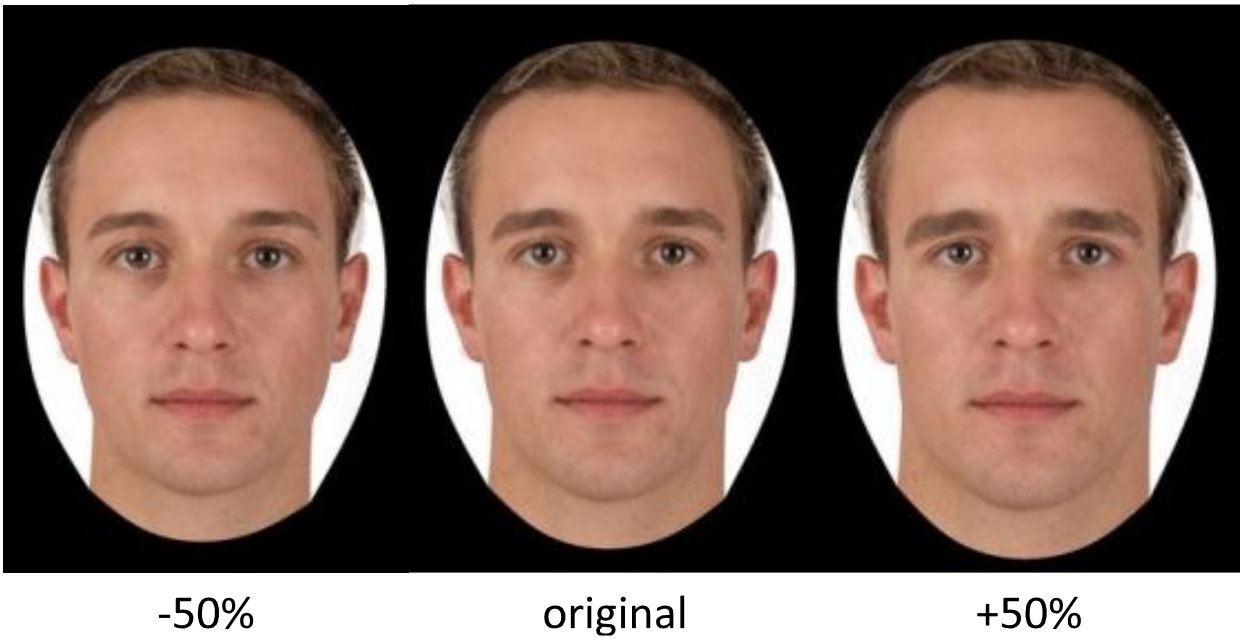

Figure 1.1. Example of a masculinity transform, including an original face, and the same face manipulated 50% towards an average female face shape (-50%) and 50% towards an average male face shape (+50%). Several studies have shown that masculinizing human faces makes them appear more physically dominant.

Masculinizing faces increases perception of physical dominance, and recent research suggests that perceived dominance and masculinity correlate with actual measures of physical dominance. Levels of testosterone, the primary male sex hormone, correlate with physical and verbal aggression, as well as aggressive responses to provocation and threat (Archer, 1991; Mattsson, Schalling, Olweus, Low, & Svensson, 1980; Mazur & Booth, 1998; Olweus, Mattsson, Schalling, & Low, 1980, 1988). Faces of men with high testosterone levels are perceived as more masculine (Penton-Voak & Chen, 2004; Roney, Hanson, Durante, & Maestripieri, 2006) and more physically dominant (Moore, Al Dujaili, et al., 2011; Swaddle & Reierson, 2002). One study found that perceived facial masculinity and dominance correlate with an indicator of prenatal testosterone level (2D:4D finger ratio; Neave, Laing, Fink, & Manning, 2003), though not circulating testosterone. Men with masculine face structure exhibit greater surges in circulating testosterone in response to winning competitions than men with less masculine faces (Pound, Penton-Voak, & Surridge, 2009). These studies indicate that perceived facial masculinity and dominance are associated with actual measures of testosterone, a hormone associated with dominant behaviour.

While testosterone influences aggressive behaviour, body size and strength are crucial for success in physical competitions. Ratings of physical dominance and masculinity from face images have been found to correlate with handgrip strength (Fink, Neave, & Seydel, 2007; Windhager, Schaefer, & Fink, 2011), mid-arm circumference (including the bicep, a muscle highly correlated with physical strength; Undurraga et al., 2010) and shoulder width (Windhager et al., 2011). Sell et al. (2009) discovered that naïve participants could accurately assess men’s upper body strength (as determined by weight lifting measures like arm curls, abdominal crunches, chest presses, and super long pulls) from face images alone. Furthermore, a separate group of participants rated men's faces for how likely they would be to win a fight with a same-sex conspecific. Ratings of fighting ability almost perfectly correlated with ratings of physical strength (r=0.96), and also correlated with actual upper body strength. Separate studies also found that participants could assess upper body strength from women's faces, (although not as well as in men's faces), and that participants could assess accurately physical strength from faces of men from different cultures (for example, American students could assess fighting ability in the Tsimane people of Bolivia; Sell et al., 2009). These studies indicate that people can assess both physical strength and fighting ability from facial appearance alone.

One quantifiable facial dimension that is thought to be associated with aggression is facial width-to-height ratio (fWHR). Facial width-to-height ratio was originally thought to be a sexually dimorphic face trait independent of body size (Weston, Friday, & Lio, 2007), with men having a relatively larger fWHR than women. One study found that fWHR was correlated with the number of aggressive penalty minutes in varsity and professional ice hockey players (Carre & McCormick, 2008), while another found that high fWHR was associated with perceived aggression in facial photographs (Carre, McCormick, & Mondloch, 2009). Men with high fWHR were found to be less trustworthy in economic games, and were also trusted less by other participants (Stirrat & Perrett, 2010). One comprehensive forensic analysis found that men with lower fWHR were more likely to die in physical confrontations, even though men with higher fWHR are assumed to get involved in more violent acts (Stirrat, Stulp, & Pollet, 2012). The authors interpret this result as an indication that males with higher fWHR are more likely to survive and succeed in physical confrontations. Recent research suggests that fWHR may not be a sexually dimorphic trait after all (Lefevre et al., 2012; Özener, 2011), and other studies have found no correlation between fWHR and aggression (Deaner, Goetz, Shattuck, & Schnotala, 2012; Gomez-Valdes et al., 2013), however a wealth of empirical evidence suggests that fWHR is linked with perceived aggression and may be a reliable indicator of dominant behaviour. Chapters 3 and 7 will discuss the role of fWHR in leadership selection and performance.

The studies cited above have demonstrated that perceived facial dominance in men is correlated with testosterone levels and measures of human strength and aggression. Further studies have been conducted to determine how facial dominance influences human social interaction. For example, Mueller and Mazur (1996) found that the rated facial dominance of West Point cadets correlated positively with social status and rank later in their military careers. Chapter 3 will discuss how perception of facial dominance relates to hypothetical and real-world voting behaviour, and Chapter 9 will report results of an experiment analysing the association between perceived dominance and leadership ability.

1.2 Facial cues to height

1.2.1 Skull shape associated with physical height

Very few scientific articles have examined how face shape varies with physical body height. There are a handful of studies that examine correlations between skull shape and physical height. While these studies are written for use in forensic science (forensic laboratories often have to identify the remains of a human from skulls alone, and an estimate of approximate height can be valuable), they are a good source for determining if there are any correlations between skull dimensions and physical height.

Chiba and Terazawa (1998) conducted a study of on skulls of Japanese adults to assess whether skull dimensions were correlated with physical height. The skulls of 77 men and 47 women (recently autopsied) were measured to find the diameter of the skull from the glabella (the most anterior projecting point on the eyebrow ridge, found between the eyebrows) to the external occipital protuberance (a point on the back of the skull). They also measured the circumference of the skull through the glabella and the external protuberance. Chiba and Terazawa found a moderate (r=0.39) correlation between the diameter of the skull and physical height for men, but not women (r=0.003). Skull circumference was also moderately correlated with physical height for men (r=0.38) and women (r=0.32).

Since the study by Chiba and Terazawa (1998), several studies have examined further skull dimensions and their correlation with physical height. Patil and Mody (2005) examined the skulls of 150 living Indian adults (75 men and 75 women) and determined regression equations for physical height based on skull diameter from the glabella to the opisthocranion (the most posterior point of the back of the skull; the furthest point from the glabella). They found that male height could be accurately estimated by the equation 9.323724 x diameter, while female height could be estimated by 9.19782 x diameter. Ryan and Bidmos (2007) later used autopsied skeletons and skulls to search for skull dimensions that best correlated with physical height in South African men and women. They found that skull height (loosely defined as the vertical distance from the top of the skull to where the spinal cord enters the skull) to be the best predictor of male height (r=0.4), while the maximum width of the skull (the horizontal distance between the two temporal crests) best predicted female height (r=0.45). This study demonstrated physical height was best predicted by different skull dimensions for men and women. The largest study of skull dimensions and physical height was conducted by Krishnan (2008), who measured the skull dimensions of 966 living adult men from north India. Skull diameter (glabella to the opisthocranion) was the best predictor of height in this sample (r=0.78), though head width (r=0.68) was also a significant predictor. While this study used by far the largest sample size, it should be noted that no females were measured. More recently, Pelin et al. (2010) measured a sample of 286 adult Turkish men and found once again that skull diameter was the best predictor of male height, though their sample size lead to a smaller correlation coefficient (r=0.23) than that found in Krishnan (2008).

While estimates of physical height from skull dimensions are useful in the forensic field, they are of limited use in facial photographs. Dimensions such as skull diameter cannot be measured from frontal 2D photographs. Furthermore, skull dimensions used in forensic science are based on absolute measurements. The facial photographs used in face perception studies are often standardized by interpupillary distance (the distance between the two pupils) in order to eliminate large differences in face size between stimuli. The skull dimensions used to estimate physical height in forensics therefore cannot be used to estimate height in typical face perception studies.

1.2.2 Face shape associated with physical height

Very few empirical studies have been conducted to assess whether face shape (as opposed to overall skull dimensions) is correlated with height. Windhager et al. (2011) collected frontal face images of 26 Caucasian men (images were standardized for head positioning and camera height) and delineated the photographs with 70 facial landmarks. The average configuration of landmarks for the 26 faces were placed on a grid, and individual faces could be compared to the average by changes in the grid structure. Face shape was analyzed with a partial least squares analysis to determine the covariance in face shape associated with physical height, body fat, grip strength, shoulder width, perceived dominance, perceived masculinity, and perceived attractiveness (the perceptual variables were rated by 77 female raters). While no quantitative claims on face dimensions could be made from this analysis, Windhager et al. (2011) reported that faces of taller men were narrower and longer, as visualized by a vertical stretching of the grid structure. Face shape associated with tall physical height was similar to that perceived as attractive by female raters. The long, narrow face shape correlated with tall physical height was distinct from face shape associated with shoulder width, body fat, grip strength, perceived dominance and perceived masculinity, which were wider and rounder by comparison, with a grid structure that was horizontally stretched from the average configuration (see Figure 1.2). Windhager et al. (2011) were the first to report qualitative face shape characteristics associated with physical height. It is important to note, however, that this study did not assess perception of height (i.e., how tall the photographed men appeared to be from face pictures), rather the authors only examined the correlation between physical body height with other body measures and perception of dominance, masculinity and attractiveness.

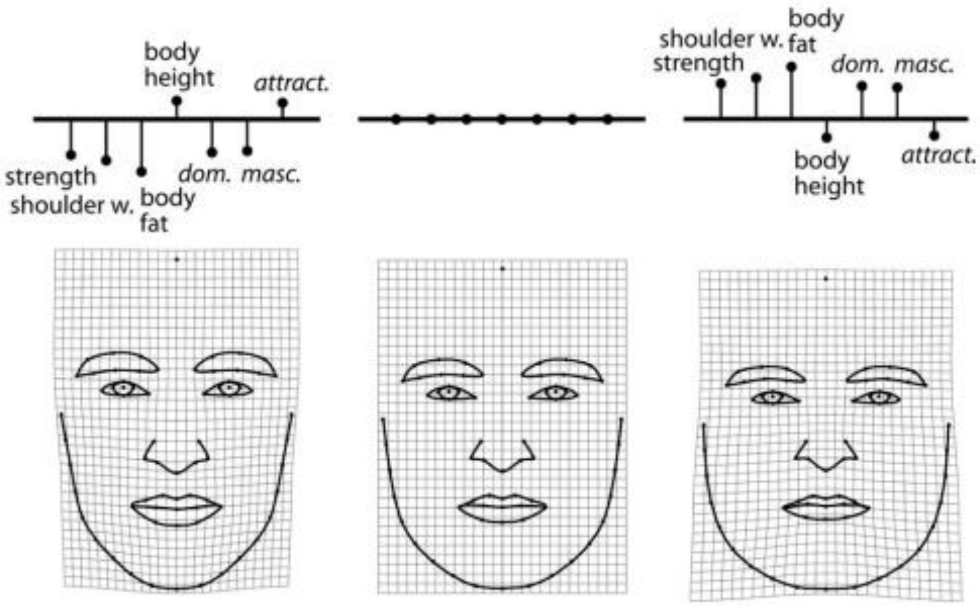

Figure 1.2. Face shape and their relation with real measures of height, strength, shoulder width, and body fat, as well as perceptual measures of dominance, masculinity and attractiveness. Faces of taller men are longer and narrower, and were perceived as more attractive but less dominant than faces of shorter men. Taken from Windhager et al. (2011).

While face shape associated with physical height was qualitatively distinct from that associated with perceived dominance in Windhager et al. (2011), it is possible that face shape that makes a person *appear* taller would also be perceived as dominant. That is, face shape perceptually associated with tall physical height may also be perceptually linked with physical dominance. Chapters 4, 7, 8 and 9 will examine the links between face shape and perceived height, attractiveness, dominance and leadership ability.

1.3 Facial adiposity

Body weight has a large effect on social perception, but facial cues to body weight were not empirically analyzed until recently. Coetzee, Perrett, & Chen (2009) first examined facial adiposity (defined as “the perception of weight in the face”; Coetzee et al., 2009) as an accurate cue to physical health. Coetzee et al. (2009) instructed participants to rate 84 Caucasian faces (43 females, 41 males) for weight (0=very underweight; 3=average weight; 6=very overweight) and found that rated weight (or perceived facial adiposity) was an accurate predictor of actual body mass index (BMI; a measure of body weight scaled for height; Figure 1.3). They also found that rated facial adiposity predicted both perceived attractiveness and perceived health

a) b)

Figure 1.3. Face composites from people with a) high body-mass index (BMI; mean BMI: 21.65) and b) low body-mass index (mean BMI: 27.6). BMI is a measure of weight scaled for height.

ratings with a quadratic function (i.e. faces rated as average weight were perceived as healthier and more attractive than those rated underweight and overweight). Finally, Coetzee et al. (2009) showed that individuals with high facial adiposity reported longer and more frequent respiratory infections and more antibiotic use than those with low facial adiposity (The World Health Organization defines people with a BMI under 18.5 as underweight and a BMI over 25 as overweight; World Health Organization, 2006). The correlations between facial adiposity and self-reported health were similar to those between actual body mass index (BMI) and self-reported health. These results demonstrate that facial adiposity is not only an accurate predictor of actual BMI, but also alters perception of attractiveness and health, and predicts actual health measures.

Coetzee, Chen, Perrett & Stephen (2010b) followed the original facial adiposity paper by determining the proximate dimensions that influence perceived adiposity. Coetzee et al. (2010b) defined three face dimensions (visible in frontal 2D facial photographs) that may influence perceived adiposity: perimeter-to-area ratio of the lower half of the face (perimeter of the face up to the eyes, with a horizontal line across the pupils forming the top boundary / area of this region), facial width-to-height ratio (maximum width across the cheekbones / length of the face from the top of the eyelids to the top of the upper lip) and the cheek-to-jaw width ratio (the maximum width of the face across the cheekbones/the maximum width of the jaw as defined by a horizontal line across the middle of the lips) (Figure 1.4). All of these ratios were predicted to alter perceived adiposity as they encompass the buccal fat pads located in the cheeks which hold a large percentage of the fat stored in the face (Kahn, Wolfram-Gabel, & Bourjat, 2000; Tostevin & Ellis, 1995). In a meta-analysis of the faces of two Caucasian populations (43 females and 41 males in the first, 52 females and 54 males in the second) and one African populations (51 females and 45 males), Coetzee et al. (2010b) found that perimeter-to-area ratio, width-to-height ratio, and cheek-to-jaw ratio all independently predicted perceived adiposity for both female and male faces. Specifically, width-to-height ratio predicted perceived adiposity positively (r=0.43 for females and males), while perimeter-to-area (r=-0.37 for women, -0.36 for men) and cheek-to-jaw width (r=-0.51 for women, -0.43 for men) predicted perceived adiposity negatively. Furthermore, these ratios showed similar correlations with actual BMI with the exception of perimeter-to-area ratio in female faces. These results both established facial dimensions that influenced perceived facial adiposity and revealed that these dimensions were correlated with actual BMI.

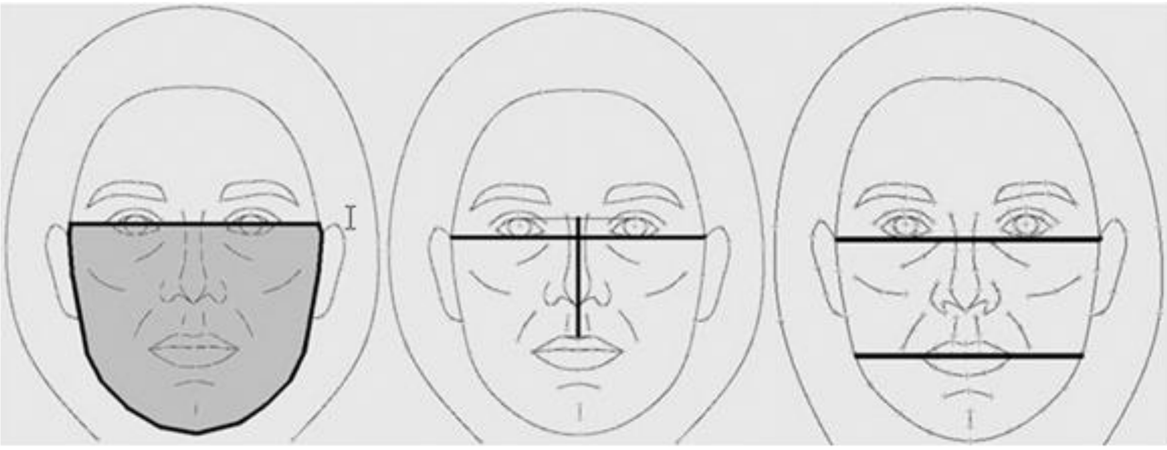

Figure 1.4. Measures of perimeter-to-area ratio (left), width-to-height ratio (middle), and cheek-to-jaw-width ratio (right) as defined by Coetzee et al. (2010). Width-to-height ratio had a positive correlation with facial adiposity, while perimeter-to-area ratio and cheek-to-jaw ratio correlated negatively with facial adiposity.

While Coetzee et al. (2009) found that perceived facial adiposity showed a quadratic relationship with perceived attractiveness (faces of average perceived adiposity were rated as more attractive than faces of underweight or overweight people), two recent papers have examined this relationship more closely. Coetzee, Re, Perrett, Tiddeman & Xiao (2011) were able to create a computer program that allowed participants to manipulate Caucasian female faces to increase or decrease adiposity in order to maximize attractiveness or perceived health. Furthermore, they were able to calculate the BMI values represented by the chosen level of adiposity (similar methods are explained in detail in Chapter 5). Coetzee et al. (2011) found that female participants manipulated female faces to represent a BMI of 19.76 kg/m^2 to maximize attractiveness, yet chose a BMI of 20.84 kg/m^2 to maximize perceived health. These BMI values were significantly different, indicating that British women show a disparity in what they believe to be most attractive and most healthy in terms of facial adiposity. Male participants did not show this disparity, choosing BMI values of 20.01 kg/m^2 to maximize attractiveness and 19.63 kg/m^2 to maximize health.

More recently, Coetzee et al. (2012) tested whether facial adiposity affected perceived attractiveness in faces of African females. Coetzee et al. (2012) tested whether preferences for facial adiposity were linear or curvilinear in using facial photographs of 45 female university students from the University of Pretoria. In a regression analysis with three other variables that influence facial attractiveness (skin colour, skin heterogeneity, and age), perceived facial adiposity had a significant effect on attractiveness (β=-0.18, η_p^2=0.12). Contrary to findings in Britain however, the results from 30 African participants revealed that a linear preference for facial adiposity, with faces of underweight people (which made up 20.5% of the photographic sample) being preferred more than healthy or overweight people. Coetzee et al. (2012) make the caveat that this result may only be true to the African elite (university students in South Africa) who may be susceptible to the new African body ideal that glorifies thin bodies, much like western cultures (Coetzee & Perrett, 2011).

Coetzee et al. (2009) demonstrated that facial adiposity negatively correlated with measures of cardiovascular health. Two studies have extended these findings to other measures of health. Reither, Hauser and Swallen (2009) conducted a study in which they gathered 3027 yearbook photographs from high schools in 1957. They had participants rate all of the photos for relative weight on a 1-11 scale (similar to facial adiposity ratings collected by Coetzee et al. 2009). Ratings of weight from the yearbook photographs were significantly correlated with actual weight and measures of health problems later on in life (i.e. muscle aches, back and chest pain, shortness of breath, etc.). Those rated overweight from yearbook photographs had a two-fold increase in risk of dying prematurely, and a fourfold increase in risk of dying of heart disease. Furthermore, perceived facial weight was a better predictor of mortality than objective measures of body weight such as BMI. These findings demonstrate that ratings of weight from faces correlate with actual health beyond current and past respiratory problems, and are indicative of potential health problems in the future.

Coetzee et al. (2009) and Reither et al. (2009) showed that perceived facial adiposity is indicative of physical health. Tinlin et al. (2012) examined how ratings of facial adiposity correlated with measures of mental health. In a sample of 50 women's faces, they found perceived adiposity was correlated with poor mental condition (as defined by a self-report on stress, anxiety, depression and mood scales). They also found that high ratings of facial adiposity correlated with lower physical health (as defined by a self-report of frequency of physical ailments including running and congested nose, diarrhoea, nausea, headaches, etc.), in accordance to the facial adiposity-health relationship found in Coetzee et al. (2009) and Reither et al. (2009). The results of Tinlin et al. (2012) show that not only is facial adiposity associated with attractiveness and real and perceived of physical health, it is also associated with real measures of mental health, as well.

1.4 Summary

Several studies have examined how facial appearance can alter perception of physical dominance. The majority of these studies have focused on how masculinization of face shape affects perceived dominance, and how dominance ratings correlate with actual measures of aggression and strength. Recent research has revealed that perception of fighting ability correlates with actual measures of upper and lower body strength in men and women, a finding that extends to impressions of faces from various cultures. Taken together, these studies indicate that dominance judgments made from face images are reliable cues to actual physical dominance.

Relatively few studies have examined how facial appearance is associated with body height and weight. Some research indicates that height can be estimated by skull dimensions; however these findings are of little use in face perception research due to the custom of standardizing facial photographs for size. One study has found that taller people have longer, narrower faces, but did not define any measurable parameters for this observation. Facial adiposity is a face parameter associated with body weight; however its relatively recent discovery means that few studies have been conducted to test for its effects on social judgments. Facial adiposity influences attractiveness, with optimal levels representing a BMI towards the light end of the healthy range (~18-21 kg/m^2). Facial adiposity also correlates with measures of physical and mental health, with overweight people more likely to suffer from poorer health.

While studies on facial cues to perceived dominance have focused mainly on masculinity, it is important to note that body stature is correlated with actual physical dominance (Melamed, 1992). To that end, it is perhaps strange that relatively few studies have examined how facial cues to body height and weight influence perceived dominance. Conceivably, any facial cue that enhances perception of body size should also be associated with perceived dominance. As will be discussed in Chapter 3, dominance is also associated with leadership perception; therefore facial cues to body size should influence leadership perception, as well. With this in mind, Chapters 6,7,8 and 9 will examine how facial cues associated with perception of height and weight affect perceived dominance and leadership ability.

Chapter 2: Facial attractiveness

2. Attractiveness

Most every aspect of human social interaction is influenced by attractiveness in some way. It may come as no surprise that people with attractive faces are preferred as sexual partners (Perrett, 2010), and that attractive people have greater reproductive success (Rhodes, Simmons, & Peters, 2007). The effects of facial attractiveness extend well beyond mating success. Attractive people enjoy positive stereotypes including higher perceived intelligence, social competence, and likability (Eagly, Ashmore, Makhijani & Longo, 1991; Agthe, Sporrle & Maner, 2011). Attractive students are judged more favourably by their teachers (Ritts, Patterson & Tubbs, 1992) and attractive people have advantages in job-related outcomes, including getting hired, gaining promotions, and being positively evaluated in performance reviews (Hosoda, Stone-Romero & Coats, 2003). As Chapter 3 will discuss, attractive people also enjoy advantages in leadership selection, as well. Attractive faces activate reward centres in the brain (Aharon et al. 2001, O'Doherty et al. 2003), indicating that attractiveness is inherently desirable to humans. While aspects of facial attractiveness can be specific to particular regions (such as masculinity preferences described in section 2.4), there are some elements of facial appearance that have universal effects on attractiveness. Facial attractiveness has been the focus of a plethora of empirical studies. This chapter describes features that have been found to be significant components to facial attractiveness across cultures.

2.1 Averageness

Galton (1878) first noted that superimposing images of individual faces created a composite face that was more attractive than any component faces. Galton observed:

“All composites are better looking than their components, because the averaged portrait of many persons is free from the irregularities that variously blemish the looks of each of them” (Galton, 1878).

Langlois and Roggman (1990) empirically tested whether averaged faces are more attractive than their component faces. They used computer software to mathematically average 8, 16, or 32 faces and found that composites were more attractive than individual faces. Langlois and Roggman (1990) hypothesised that facial composites were similar to a mental template of a face, or more “facelike,” without any irregularities that can be found in an individual faces (Langlois & Roggman, 1990). If this were true, a face could not get more attractive than the most average configuration for a population. The idea that average facial configurations are the most attractive came to be known as the “averageness hypothesis.”

The averageness hypothesis was drawn into question by several studies. Alley and Cunningham (1991) argued that perceived facial attractiveness should reflect indicators of mate quality (such as youthful looks in women’s faces and the appearance of strength in men’s faces). By definition, an average face configuration would not possess these characteristics in the extreme, rather would represent the average level of mate quality indicators in the faces of a population. Furthermore, Alley and Cunningham (1991), Benson and Perrett (1992) and Penton-Voak and Perrett (2001) explained how computer-averaged faces were more symmetrical and possessed more homogenous skin texture which may have artificially enhanced facial attractiveness. Little and Hancock (2002) found that averaging skin texture, a process that occurs in the construction of composite faces, did in fact make faces more attractive. Perrett, May, and Yoshikawa (1994) found that female face composites made from the most attractive

25% of a sample of 60 women's faces were more attractive than a composite made from the entire sample (skin texture was held constant in this study). Moreover, attractive face composites were made more attractive by manipulating shape configuration away from the mean of the whole sample population (Perrett et al., 1994). Grammer and Thornhill (1994) found that averaged faces were not attractive when symmetry was controlled for. These studies suggest that while digitally averaging faces together may make the resulting composite more attractive than the component faces, an average face shape is not necessarily the most attractive face shape possible. See Figure 2.1 for examples of face composites.

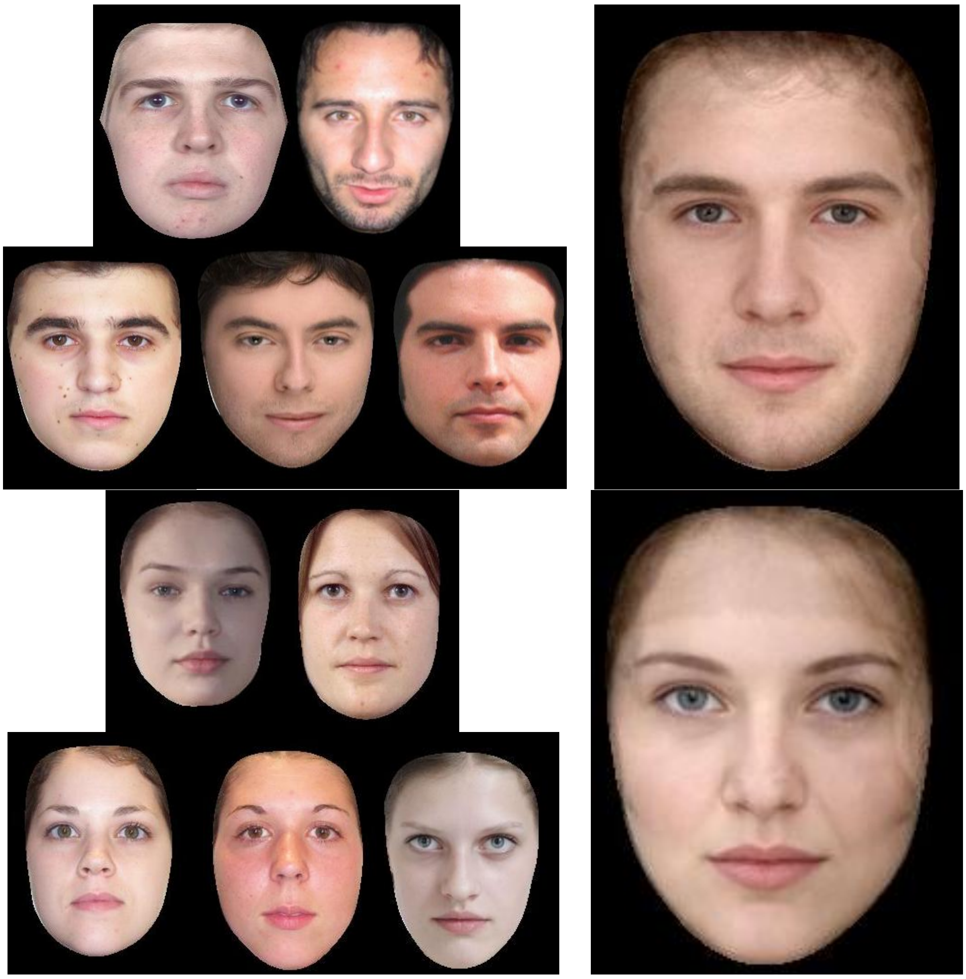

Figure 2.1. Examples of face composites (right) averaged from 20 individual images (5 examples clustered left) for men's and women's faces. Average face configurations are attractive, but not necessarily optimally attractive.

Langlois, Roggman, and Muselman (1994) countered criticism of their work by explaining that their definition of an average face referred to the mathematical averages of face configurations. Rhodes and Tremewan (1996) found that mathematical facial averageness correlated positively with attractiveness, and that facial distinctiveness (the opposite, they claimed, of averageness) negatively correlated with attractiveness in line drawings of faces. Rhodes, Sumich, and Byatt (1999) found that symmetrical faces became more attractive with increasing averageness, demonstrating that averageness plays a role on face attractiveness that is independent of symmetry. Little and Hancock (2002) found that averageness of face shape has an effect on attractiveness independent of skin texture, providing further evidence that averageness does indeed contribute to facial attractiveness.

More recent studies on facial averageness have attempted to overcome confounds present in composite faces by manipulating individual faces. Studies found that transforming individual faces towards an average face shape without manipulating skin texture do indeed make faces appear more healthy and attractive (Benson & Perrett, 1992; Little & Hancock, 2002; Rhodes et al., 2001). Another study used individual faces to find that manipulating individual Chinese and Japanese faces towards their own-race and same-sex average configuration made them more attractive (Rhodes et al., 2001). Valentine, Darling, and Donnelly (2004) used individual faces to find independent effects of symmetry and averageness by transforming side-view and front-view faces toward an average configuration. Whereas symmetry is detectable in front-view faces, it cannot be displayed in side-view faces. They found that while manipulating faces at both front-view and side-view faces toward average configurations increased attractiveness, front-view faces became more attractive relative to side-view faces, suggesting independent roles of symmetry and averageness. This view was supported by the results of Jones, DeBruine and Little (2007) who found that average faces were more attractive than less average faces when symmetry was digitally controlled in composite faces.

The debate over the averageness hypothesis was partially resolved by a comprehensive paper by DeBruine, Jones, Unger, Little, and Feinberg (2007). They found that caricaturing faces away from a mathematical face shape average of 60 faces towards the average shape of the most attractive 15 faces in that sample made faces more attractive, however these non-average faces were perceived as less normal (see Figure 2.2). Furthermore, prolonged exposure to abnormal faces was found to affect perceptions of face normality, which the averageness hypothesis states should be the most attractive face, yet adaptation did not affect perceptions of attractiveness. These experiments dissociated facial averageness from facial attractiveness. Even though average faces do not necessarily represent the most attractive face configurations possible, a wealth of empirical evidence suggest that averageness does contribute to facial attractiveness.

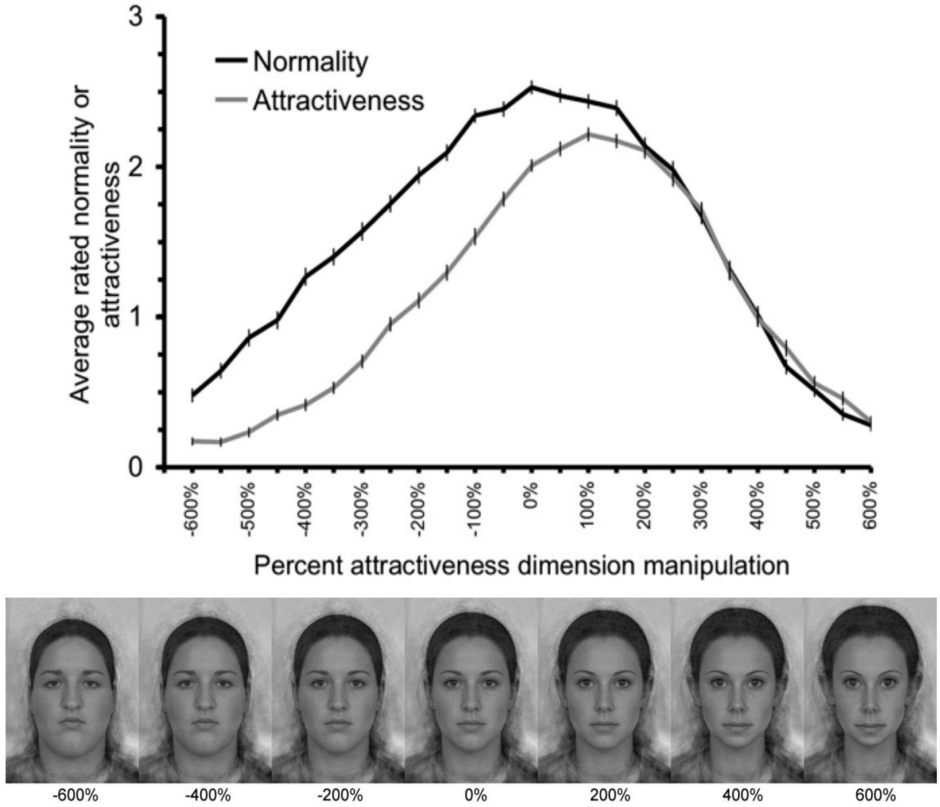

Figure 2.2. Ratings of attractiveness and normality taken from DeBruine et al. (2007). The original composite (0%) was transformed 600% towards the averaged shape of the most attractive 15 (+600%) and 600% towards the averaged shape of the least attractive 15 (+600%). The original composite was rated the most normal, but the composites that were transformed 100% towards the attractive average were rated most attractive.

2.2 Symmetry

Asymmetry in anatomical terms can refer to either directional asymmetry or fluctuating asymmetry. Directional asymmetry is an evolved natural asymmetry (Thornhill & Moller, 1997), an example of which is the human heart, which lies on the left side of the body. Fluctuating asymmetry refers to asymmetry in an individual that caused by developmental instability for a trait that is symmetric across a population (Palmer & Strobeck, 1986; Thornhill & Gangestad, 1996). For example, eye size for the left and rights eyes is symmetric across a population, and any asymmetry in this trait in an individual would be fluctuating asymmetry. Fluctuating asymmetry is thought to reflect developmental stability and is thus an indicator of mate quality (Gangestad & Simpson, 2000; Moller, 1997; Moller & Thornhill, 1998). In this section, "symmetry" will refer exclusively to fluctuating asymmetry.

Early studies on facial symmetry found preferences for asymmetrical faces (Kowner, 1996; Langlois et al., 1994; Samuels, Butterworth, Roberts, Graupner, & Hole, 1994). These studies, however, produced their symmetrical stimuli by taking half of a face (divided by a vertical midline) and 'mirroring' it on the other side, the product of which is called a chimera. Chimeras often appear abnormal, as distortions present on one side of the face are mirrored on the other. For example, consider a face with a nose that is slightly crooked to the right. The vertical mid-line of the face would then not separate the nose into two equal halves; rather the right side would feature more of the nose than the left. A chimera of the right side of the face will then produce a face with an abnormally large nose, while a chimera of the left will produce a face with an abnormally small nose. While both chimeras may be symmetrical, they both have non-average features which may reduce their attractiveness.

a) b)

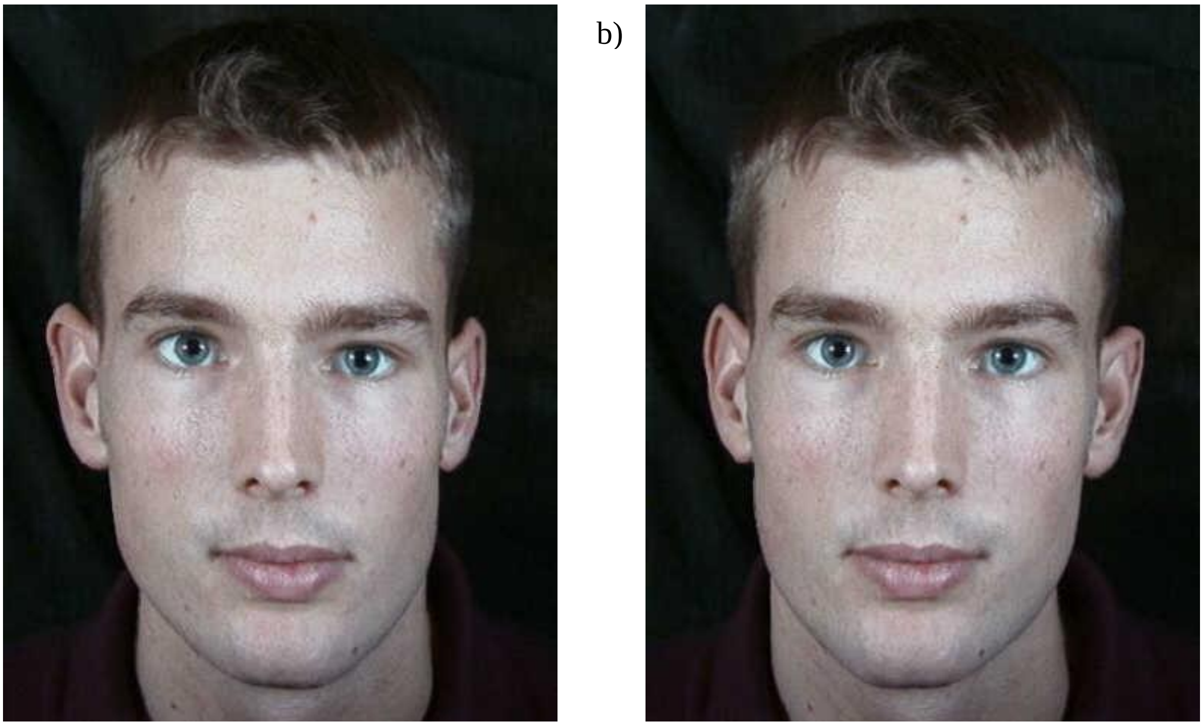

Figure 2.3. Faces with a) low and b) high symmetry as created by transforming structural landmarks. Faces with high symmetry are perceived as healthier and more attractive.

Later studies in facial symmetry used more technologically advanced computer manipulations to avoid confounds present in using mirror-image chimeras. Perrett et al., (1999) produced symmetrical stimuli by digitally marking face structure landmarks and distorting the image surface. By altering the positions of two paired points on opposite sides of the vertical midline of a face, Perrett et al. (1999) were able to alter facial symmetry without creating the odd appearance found in chimeras. Perrett et al. (1999) found that more structurally symmetrical faces were more attractive than faces with lower symmetry (Figure 2.3). Structurally symmetrical faces have been found to be preferred in both natural and digitally manipulated faces (Little, Jones, Burt, & Perrett, 2007; Penton-Voak et al., 2001).

In accordance with developmental theories behind symmetrical features, face symmetry has been found to positively correlate with perceived health (Jones, Little, Feinberg, et al., 2004; Rhodes et al., 2001). People with high fluctuating asymmetry also self-report more frequent bouts of respiratory illness (Thornhill & Gangestad, 2006). Further supporting the idea that facial symmetry indicates high genetic quality, Little, Burt, Penton-Voak, and Perrett (2001) found that women's preferences for symmetry correlate with their own perceptions of attractiveness. Little and Jones (2012) found that women's preferences for symmetrical male faces were higher during the fertile phase of their menstrual cycle when judged in a short-term relationship context, but not in a long-term context. These results demonstrate that facial symmetry may be indicative of heritable benefits to offspring (i.e. – "good genes"), which more are appealing to women when they are more likely to conceive and benefit from the mate quality of their sexual partner. Preferences for symmetry in opposite-sex faces are also higher after exposure to visual cues of pathogen contagion, such as images of body fluid stains on a white cloth. These results indicate that the heritable genotypic quality indicated by facial symmetry is more heavily favoured in environments where contagion risk is perceived to be higher.

2.3 Skin condition

Several studies have focused on the role that skin texture and colour has on facial attractiveness. Barber (1995) detailed how skin condition could indicate age and health, an idea that applies to facial skin. Humans prefer skin that is relatively free from lesions and unnatural growths and protrusions (warts, fungus, etc.) as these skin anomalies indicate poor health (Symons, 1995). A number of recent studies have demonstrated how important skin condition is to facial attractiveness.

2.3.1 Skin texture

Fink, Grammer, and Thornhill (2001) found that skin texture homogeneity (even skin texture) was preferred by men looking at women's faces (aged 18-25), perhaps as an indicator of youth and fertility. Skin patches from the cheeks of symmetrical faces were rated as more healthy than those from asymmetric faces (Jones, Little, Burt, & Perrett, 2004). Jones et al. (2004) found that superimposing skin texture rated as healthy make faces more attractive than when the same face structures have skin textures that are rated unhealthy (Jones, Little, Burt, et al., 2004). While skin texture homogeneity seems to be attractive, one study found that, in black and white images, slight scarring of men's faces increased attractiveness in a short-term relationship context (Burriss, Rowland, & Little, 2009). It is likely, however, that scarring is attractive due to increased perceived masculinity, not skin texture. This interpretation is supported by the fact that the effect is only found in short–term relationship contexts (when preferences for masculinity in other domains are stronger; Little, Jones, & Burriss, 2007; Puts, 2005).

2.3.2 Skin colour

Skin colour also plays a role in attractiveness. When skin colour distribution from young women's faces are applied to whole faces, they are rated as younger, healthier, and more attractive than when colour distribution from older faces are applied (Fink, Grammer, & Matts, 2006). As with skin texture, colour homogeneity (even skin colour) is preferred in women's faces over high variation in skin colouration (Matts, Fink, Grammer, & Burquest, 2007). Increasing skin colour homogeneity can decrease perceived age by five years (Fink & Matts, 2008). If skin colour homogeneity increases along with skin topography homogeneity (evening out wrinkles, etc.), perceived age can decrease by fifteen years (Fink & Matts, 2008). Burt and Perrett (1995) found transforming skin colour using young (age: 20-24) and old (age: 50-54) prototypes successfully altered perceived age accordingly. Tiddeman, Burt and Perrett (2001) found that applying colour and texture information through a wavelet-based method will alter perception of age even more than the colour transformation used in Burt and Perrett (1995), which blends texture while transforming. Jones et al., (2004) found that skin colour affects facial attractiveness through altering perceptions of health. Recent studies have found three main skin colour components affecting facial attractiveness: redness, yellowness, and lightness (Stephen, Smith, Stirrat, & Perrett, 2009).

Skin redness indicates oxygenated blood levels that increase with respiratory health (Armstrong & Welsman, 2001). High physical fitness increases skin redness (Johnson, 1998), as does oestrogen in women (Thornton et al., 2006). There is evidence that testosterone increases skin redness in some primates species (rhesus macaques, Rhodes et al., 1997; male mandrills Setchell & Dixson, 2001) thus high skin redness may indicate high mate quality as suggested in the handicap hypothesis (Folstad & Karter, 1992). By contrast, high levels of deoxygenated blood give the skin a bluish associated with cardiac and respiratory illness (Ponsonby, Dwyer, & Couper, 1997). Thus, skin redness acts as an indicator of health and mate quality. Stephen, Coetzee, Law Smith, and Perrett (2009) allowed participants to transform face redness in a realistic fashion (simulating blood oxygenation levels) to optimise perceived health (Figure 2.4a). They found that participants increased oxygenated blood levels for 98% of all faces. Furthermore, participants increased redness more for faces that were lower in starting redness. They also increased redness more for male faces than female faces. Re et al. (2011) conducted a psychophysical test to assess whether preferences for skin redness was the product of a sensory bias for skin colouration. They discovered that the change in skin redness required to alter perceived attractiveness (ΔE=1.44, where ΔE is a standard means of calculating colour changes across images) was larger than that needed to notice a difference in colouration (ΔE=0.67). Re et al. (2011) interpreted this result as a demonstration that attraction to redness reflects a reliable colour cue to cardiovascular health, not just a sensory bias towards redness.

Skin yellowness is altered by carotenoid consumption and melanin (Edwards & Duntley, 1939; Stamatas, Zmudzka, Kollias, & Beer, 2004; von Schantz, Bensch, Grahn, Hasselquist, & Wittzell, 1999). Carotenoids are found in fruits and vegetables, and are used to help resist free radical damage that occurs when fighting disease (Alaluf et al., 2001). High skin yellowness reflects high levels of carotenoids which is indicative of good health. Carotenoids are used up in fighting and averting illness, thus decrease skin yellowness indicates a lower general health. For example, those afflicted with HIV or malaria have low carotenoid levels (Friis et al., 2001). Stephen et al. (2009) allowed participants to transform faces in yellowness in a fashion simulating carotenoid and melanin pigmentation (Figure 2.4b). They found that participants increased skin yellowness to optimise perceived health, and increased yellowness more in faces with lower starting yellowness. Participants also increased yellowness more in male faces than female faces.

Whitehead et al. (2012) examined how skin colouration changes with consumption of carotenoids. A longitudinal study of 35 participants revealed that increasing fruit and vegetable consumption over a six-week period is enough to increase skin yellowness and redness. A psychophysical analysis revealed that a carotenoid increase equivalent to an extra 3.3 portions of fruits and vegetables was enough to make participants reliably more attractive. The effects of carotenoid consumption on facial attractiveness has been replicated across cultures (Whitehead, Coetzee, Ozakinci, & Perrett, 2012). Results of these studies could motivate people towards a healthier diet through the incentive of increasing their own attractiveness (Whitehead, Ozakinci, Stephen, & Perrett, 2012).

Skin lightness is primarily affected by melanin, with higher melanin pigmentation making skin darker (but also making skin yellower). Melanin protects from UV radiation by filtering UV rays, preventing skin cancer and sunburn (Robins, 1991). Melanin also prevents pregnancy defects in women (Omaye, 1993). High melanin levels incur a health cost, however, as its UV filtering properties inhibit vitamin D synthesis, which could lead bone-related deformities (Jablonski & Chaplin, 2000). In general, women have lighter skin than men (Edwards & Duntley, 1939; Van den Berghe & Frost, 1986), perhaps because high levels of vitamin D are required during pregnancy for increased calcium absorption and bone development (Jablonski & Chaplin, 2000). Stephen et al. (2009) found that, given the opportunity, participants increase skin lightness (simulating lower melanin levels) to optimise perceptions of health (Figure 2.4c). In accordance to natural colour dimorphism, participants lightened female faces more than male faces. Preferences for light skin in women have been found across cultures (Van den Berghe & Frost, 1986), and may reflect the need for increased vitamin D synthesis (Jablonski & Chaplin, 2000).

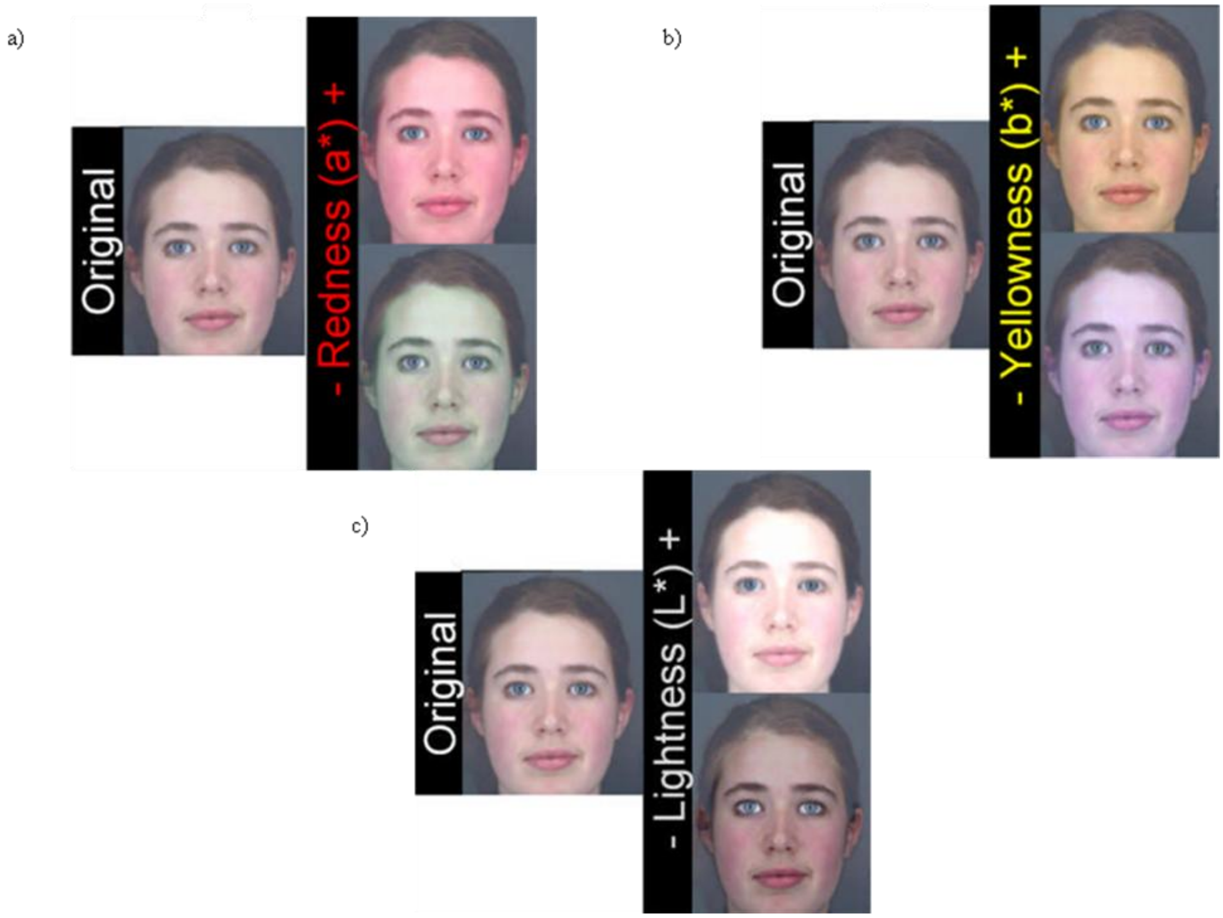

Figure 2.4: Examples of original images and increased and decreased facial a) redness, b) yellowness, c) lightness. Increases in all colours are preferred for both men and women. Images taken from Stephen et al. (2009).

Studies on skin coloration have been of great interest to researchers and the public. Increasing skin redness and yellowness and lightness enhances facial attractiveness across cultures (Stephen et al., 2012) and skin condition is different from facial averageness, symmetry or dimorphism in that it represents a current, alterable cue to mate quality that will differ with health status (Scott, Pound, Stephen, Clark, & Penton-Voak, 2010; Stephen et al., 2012). Appearance-based incentives to exercise and consume more fruits and vegetables are a good example of sexual selection research impacting daily decisions (Whitehead, Ozakinci, & Perrett, 2012).

2.4 Facial dimorphism

Facial dimorphism (also referred to as "sex typicality") refers to the masculinity or femininity of a face. Preferences for facial dimorphism have been investigated in dozens of studies, sometimes with discrepant results. As facial dimorphism affects perceptions of men's and women's faces differently, I will review the literature for each sex separately.

2.4.1 Femininity in women's faces

Facial femininity is characterised by large eyes, full lips, a small, pointy chin, and high cheek bones (Figure 2.5). Oestrogen, the primary female sex hormone, is largely responsible for the development of feminine facial features by inhibiting the masculinising effects of testosterone, as described below. Law-Smith et al. (2006) found that facial femininity correlated with levels of circulating oestrogen for women in the late-follicular phase of their menstrual cycle. Oestrogen has been linked to higher success rates in conceiving (Lipson & Ellison, 1996), thus facial femininity may indicate a higher reproductive potential in women.

Figure 2.5. Faces that have been feminised (left) and masculinised (right) from an original face composite (center) of women's (top row) and men's (bottom row) faces. Feminised faces have been shown to be more attractive in women, whereas masculinity preferences in men's faces are less consistent.

The relationship between women's facial femininity and facial attractiveness is clear: femininity positively correlates with attractiveness. Perrett et al. (1998) allowed participants to masculinize or feminize female faces by taking the mathematical difference between the average male and female face shape for a population and applying some percentage of that difference to a face (as described in Chapter 1, see Figure 2.5). Perrett et al. (1998) found that participants increased femininity by 24.2% in Caucasian and 10.2% in Japanese female faces to optimize attractiveness. Since that time, several studies have demonstrated that feminine facial structure is attractive in female faces (Cunningham, 1986; Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Koehler, Simmons, Rhodes, & Peters, 2004; Rhodes, Hickford, & Jeffery, 2000).

2.4.2 Masculinity in men's faces

Testosterone, the primary male sex hormone, has immunosuppressive effects (see Muehlenbein & Bribiescas, 2005 for review), though this relationship has been called into question (Roberts, Buchanan, & Evans, 2004). Hamilton and Zuk (1982) proposed that characteristics that indicate high resistance to infection, and thus high genetic quality, should be attractive to the opposite sex. In the case of sexual dimorphism, indicators of high levels of testosterone would "handicap" a male (Zahavi, 1975), and thus only the males of the highest genotypic quality can develop these features. The "handicap hypothesis" (Folstad & Karter, 1992) states that displays of high testosterone in males indirectly indicates genotypic quality by indicating the ability to overcome the hormone's immunosuppressive effects. Indeed, indicators of high testosterone are attractive to females across a great number of mammal species (Andersson, 1994). Furthermore, males with high testosterone often develop traits useful for male-male competition (see Chapter 1), which plays a significant role in mating success for many mammals species (Andersson, 1994) and is thought to have been a crucial element to human reproductive success throughout human history (Puts, 2010).

Masculinity in male faces is characterised by several traits, including a prominent brow ridge, a 'squared' jaw, and high cheek bones (Fink & Penton-Voak, 2002; Miller & Todd, 1998; Figure 2.5). As discussed in Chapter 1, men with high testosterone levels (as measured from saliva samples) are rated more as masculine

(Penton-Voak & Chen, 2004); likewise men with higher facial masculinity show relatively higher increases in testosterone after competition (Pound et al., 2009). Furthermore, perceptions of masculinity drawn from men's faces correlate with actual grip strength (Fink, Neave, & Seydel, 2007). Findings like these indicate masculinity is clearly a distinguishable facial characteristic. Unlike the clear association between femininity and attractiveness in women's faces, however, the relationship between masculinity and attractiveness in men's faces is relatively clouded.

Whereas the handicap hypothesis suggests that women should prefer men with higher testosterone levels, empirical data on the issue has shown disparities. Perrett et al. (1998) found that women prefer feminised men's faces in Japanese and Caucasian samples. These results were replicated in different populations (Little & Hancock, 2002; Rhodes et al., 2000). Several others have found preferences for masculinity (Cunningham, Barbee, & Pike, 1990; Grammer & Thornhill, 1994; Scheib, Gangestad, & Thornhill, 1999), and yet other studies have found no general preference for facial masculinity in men's faces (Koehler, Rhodes, Simmons, & Zebrowitz, 2004; Swaddle & Reierson, 2002).

One posited explanation for the disparities in findings on masculinity preferences was that various researchers have used different methods to create their masculinised stimuli. Whereas some studies use digital transforms between average male and female face shape in their stimuli (Perrett et al., 1998, see Figure 2.5), others have used natural images of men's faces (Grammer & Thornhill, 1994; Scheib et al., 1999). One meta-analysis suggests finds femininity preferences for digitally manipulated faces, but correlations between rated masculinity and attractiveness in unmanipulated images (Rhodes, 2006). There has also been concern over the methods used in digital masculinity manipulation. There have been three main methods for digitally producing facial dimorphism: applying the linear difference between male and female prototypes to individual or composite faces (Perrett et al., 1998); applying differences in male faces pre- and post-puberty (Swaddle & Reierson, 2002), or simply applying the differences between faces rated as having high and low masculinity (Johnston et al., 2001). DeBruine et al. (2006), however, showed that women's masculinity preferences were correlated for faces created for all of these three methods.

Methodological reasons aside, the high amount of variation in women's preferences for men's facial masculinity may arise from the difference personality traits attributed to masculine and feminine faces. While masculine face structure may be a cue of heritable genetic benefits, men with high testosterone levels are more likely to have undesirable personality traits, such as dominant behavior and aggression (as discussed in Chapter 1). Furthermore, men with high mate quality can attract many mates and show low levels of monogamous relationship commitment (Booth, Mazur, & Dabbs, 1993; Burnham et al., 2003; Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002). Feminine facial characteristics in men correlate with positive personality traits (Perrett et al., 1998) such as high parental investment and faithfulness (Boothroyd et al., 2007). Thus, men's facial masculinity and femininity are associated with very different personality attributes. These differential benefits may explain a good deal of the variation in women's preferences for men's facial dimorphism.

Several studies have found masculinity preferences in situations in which "good genes" may be given priority over desirable personality traits. Women prefer more masculine faces in a short-term (primarily sexual) relationship context than a long-term relationship context (when they are more likely to prioritize personality traits like commitment and paternity interest; Jones, Conway, DeBruine, & Little, 2010; Little, Burriss, Jones, DeBruine, & Caldwell, 2008; Little, Cohen, Jones, & Belsky, 2007; Little & Jones, 2012). Masculinity preferences have been found when women are in the most fertile period of their menstrual cycle, when chances of conceiving are highest (Jones et al., 2008; Little & Jones, 2012; Penton-Voak et al., 1999), and are reduced before puberty and after menopause (Little et al., 2010). Likewise, femininity preferences are higher during the non-fertile phase of women's menstrual cycle, when hormone levels simulate pregnancy and male relationship investment is of greater importance to women (Jones et al., 2008). Women who perceive themselves to be attractive (and thus more likely to retain a high quality male) demonstrate greater preferences for facial masculinity (Little et al., 2001; Little & Mannion, 2006).

Masculinity preferences are also affected by culture. Preferences for facial masculinity are higher in cultures where paternal investment is traditionally low, indicating women select mates for genetic benefits when male commitment is unlikely (Penton-Voak, Jacobson, & Trivers, 2004). Masculinity preferences have also been shown to correlate with pathogen disgust (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010) and increase in areas with low medical care (Penton-Voak et al., 2004) perhaps due to the immunocompetence benefits associated with masculinity. In line with these findings, recent studies have reported that masculinity preferences are higher in areas of low national health (DeBruine, Jones, Crawford, Welling, & Little, 2010) and after exposure to images of pathogen contagion (Little, DeBruine, & Jones, 2011). More recent work has also demonstrated that women's preferences for men's facial masculinity is higher after exposure to images of male-male competition and after seeing images of items of high monetary value, such as expensive cars and watches

(Little, DeBruine, & Jones, 2013). These results indicate that masculinity preferences can be enhanced by awareness of male-male aggression (perhaps drawing upon the association between masculinity and perceived dominance discussed in Chapter 1) and abundance of wealth (when wealth is in abundance, females prefer cues to good genes over relationship investment). These results indicate that masculinity preferences do not just vary by individual, but can be influenced by visual exposure suggesting different environmental and social contexts.

2.4.2.1 Facial masculinity and health

Masculinity in men's faces is thought to affect attractiveness because it reflects heritable immunocompetence. Several studies have found strong correlations between perceived health and attractiveness (Henderson & Anglin, 2003; Jones et al., 2001; Kalick, Zebrowitz, Langlois, & Johnson, 1998; Krupp, DeBruine, & Jones, 2011), however relatively few empirical studies have assessed the relationship between facial masculinity and actual health. Rhodes et al. (2003) found a weak relationship between men's perceived facial masculinity and health scores in adolescence (based on medical examinations and health histories), although the faces perceived as masculine were not perceived as attractive, despite the fact they were perceived as healthy. Thornhill and Gangestad (2006) used an objective measure of facial masculinity (based on principal components analysis, described below) and found that men's facial masculinity had a negative correlation with self-reported respiratory illness frequency and duration, but no correlation with stomach illnesses. They also found that rated attractiveness had no correlation with health measures in their sample.

Preferences for facial masculinity are thought to reflect predilections for testosterone-based indicators of heritable immunocompetence; however recent studies have questioned whether face preferences are based on testosterone at all. Moore et al. (2011) used facial images of people with high and low levels of both testosterone and cortisol, a stress-related hormone that also supresses the immune system. They discovered that testosterone levels had no influence on rated attractiveness; however faces of people with low levels of cortisol were rated as more attractive than those with high cortisol levels. Moore et al. (2011) then created synthetic averages of male faces in four conditions: high testosterone/high cortisol, high testosterone/low cortisol, low testosterone/high cortisol, and low testosterone/low cortisol. They once again found that testosterone levels were not predictive of attractiveness ratings, but that the low cortisol faces were rated as more attractive than high cortisol faces in the fertile phase of the menstrual cycle. Moore et al. (2011b) extended upon this study by finding that the effects of cortisol on face preferences were reduced when testosterone levels were high. Moore et al. (2011b) interpret these results as indicating that the effects of testosterone on facial attractiveness are indirect through its moderation of the effects of cortisol on attractiveness. Moore et al. (2013) further discovered that preferences for low cortisol faces were ubiquitous in 13 countries that varied on the human development index (HDI; a scale of societal development, where higher scores indicate lower standard of living), however preferences for high testosterone faces were greater in countries with high HDI scores (countries with low standards of living, such as Cameroon and Namibia). Furthermore, Moore et al. (2013) found that women in countries with high HDI scores who prefer faces with high testosterone show greater preference for cues to low cortisol. Moore et al. (2013) also found that women in countries of high pathogen stress have greater preferences for cues to testosterone, in accordance with DeBruine et al. (2010), but preferences for low cortisol remained across levels of pathogen stress. Collectively, these results indicate that preferences for cortisol cues in the face may be more consistent than those for testosterone, which vary across different environments and cultures.

A recent study by Rantala et al. (2013) focused on whether facial masculinity is indicative of immunocompetence when accounting for facial adiposity (discussed in Chapter 1). Sixty-nine men provided were given a hepatitis B vaccination, and levels of hepatitis B antibody (the designated measure of immunocompetence) were measured 30 minutes before and one month after the shot. Testosterone levels were also measured. Rantala et al. (2013) found that facial adiposity was significantly negatively associated with antibody response and attractiveness, while facial masculinity did not correlate with attractiveness. Furthermore, facial adiposity mediated the relationship between antibody response and attractiveness, while facial masculinity did not. These results suggest that facial adiposity, a plastic cue that fluctuates with health, is a better predictor of immunocompetence than facial masculinity.

Scott et al. (2012) compiled a review of literature on preferences for facial masculinity. They argued that men's facial attractiveness is likely based more on plastic cues to current health, such as skin colour and adiposity, than a stable cue like masculinity. Scott et al. (2012) claim that facial masculinity may play a larger role in intrasexual competition between men (as discussed in Chapter 1), and preferences for masculinity may be due to women desiring competitive men, not apparent immunocompetence. Little (2012) argued that while masculinity may have a clear association with perceived dominance, the ties with health made by Rhodes et al. (2003)

and Thornhill and Gangestad (2006) cannot be ignored, and points out that modern medicine would affect the masculinity-health relationship in ways that were not possible throughout the majority of human history. Little (2012) also reiterates that preferences for masculinity are strongest during times when women would prioritise genetic benefits in a partner (i.e. – peak fertility, short-term relationships, circumstances of low paternal investment). Little (2012) cautions against the line of thought that facial masculinity has to be a cue of either dominance or mate choice, pointing out that it likely has a function in both. Scott et al. (2012b) ceded that masculinity probably does have some role in indicating both dominance and immunocompetence, but questions whether masculinity is primarily a dominance-related or health-related trait.

Chapter 1 summarized the large and established role that facial masculinity has on perceived dominance. Dozens of studies have also demonstrated that facial masculinity also affects perceived attractiveness, though this relationship is more complex. While masculinity has an undeniable relationship with how dominant and aggressive an individual appears (and indeed how dominant and aggressive they act), a wealth of empirical evidence indicates that it has a role in mate choice as well. The relative effects of perceived dominance and attractiveness will be examined in several subsequent chapters; however it is important to acknowledge that in both sexual selection and human social interaction, the effects of a cue in one domain (such as facial masculinity in intrasexual competition) do not preclude its effects in another domain (such as facial masculinity in mate choice).

2.4.2.2 Morphological masculinity

Most studies on facial dimorphism have used images digitally manipulated to represent an average male or female face (Perrett et al., 1998) or have had unmanipulated images of faces rated for masculinity/femininity (Grammer & Thornhill, 1994; Scheib et al., 1999), while some studies applied face differences from pre- to post-puberty to masculinize faces (DeBruine et al., 2006; Swaddle & Reierson, 2002). While these manipulations reliably influence perceived facial masculinity, they may not accurately represent the true morphological differences between male and female face shapes. Scott et al. (2010) used a novel geometric morphometric analysis to define facial dimorphism. They used 129 facial landmarks placed on 62 male and female faces and conducted a principal component analysis (PCA) to establish 11 major principal components (PCs) that accounted for 84.7% of the variance in face shape. Next, a step-wise discriminant analysis was conducted to determine which of those 11 PCs best differentiated male and female faces. The resulting 8 PCs were then used to predict sex, correctly classifying the sex of 96.8% of the 62 original faces. The 8 PCs were then used to create morphological masculinity scores for the 62 male faces. While this is a complex mathematical procedure, the resulting masculinity scores simply indicated how "masculine" the face was in a morphometric sense, rather than in a perceptual sense as in previous studies. Scott et al. (2010) found that morphological masculinity scores were not predictive of attractiveness ratings in male faces (though feminine face structure was attractive in female faces), rather that skin colour was more predictive of perceived attractiveness. These findings were extended upon in Stephen et al. (2012), who found that morphometric masculinity scores did not predict same-culture or cross-culture attractiveness ratings in populations of Caucasian and African participants.

It is important to note that while Scott et al. (2010) did not find a relationship between morphological masculinity and attractiveness in male faces, they did find a relationship between *perceived* masculinity and attractiveness in the same sample. More recent work indicated that morphological masculinity scores do not correlate with perceived masculinity or perceived dominance (DeBruine, Re, Perrett, Fincher, & Jones, 2013). These findings suggest that morphological measures of facial masculinity do not capture the face elements that drive perception of masculinity. It is possible that perceived masculinity is affected by elements besides face structure, such as perceived emotional expression (i.e., men with an angry or annoyed appearance may appear more masculine) or facial hair. Furthermore, traits like facial adiposity will impact the appearance of face shape without affecting the underlying bone structure. These factors may lead to the disparity between perceived and morphological masculinity, and suggests that findings between the two will not necessarily overlap. Morphological masculinity will be further discussed in Chapter 7, including a full description of the methods used to produce morphological masculinity scores.

While facial femininity has a clear correlation with perceived attractiveness in women's faces, effects of facial masculinity in men's faces are less clear. Masculinity preferences are affected by the outside environment and are flexible even within an individual. While many studies have found links between preferences for masculinity in situations where women would benefit from genetic traits the most, recent research has called into question the link between masculinity and heritable immunocompetence. Furthermore, recent studies indicate that face shape perceived as masculine is not the same as the geometric definition of masculinity. Nevertheless, it is clear from the wealth of empirical evidence that masculinity has marked effects on perceived attractiveness contingent on a number of factors. The interaction between social and environmental context on masculinity preferences provides a good example of the complexity of face perception research, a topic revisited for face preferences for leaders in Chapter 9.

2.5 Summary

Numerous studies have been conducted to examine what makes a face attractive. Though some of the reported results bear discrepancies, the effects of the four components to attractiveness reported in this chapter cannot be denied. Digitally averaging faces together produces an average face that is more attractive than the individual faces used to create it. The earliest studies on facial averageness theorised that the average face from a population was also the most attractive; however later research demonstrated that face this was not the case. Nonetheless, the average face shape and texture within a population is indeed more attractive than most individual faces, making averageness an important aspect of facial attractiveness.

Facial symmetry and skin colouration and texture both contribute to facial attractiveness. These cues likely influence attractiveness as indicators of underlying genetic quality and health. Facial symmetry is associated with perception of health, and correlates with measures of actual health. Skin colour is also indicative of underlying health, with redness and yellowness acting as a cue to cardiovascular fitness and carotenoid levels. Skin patches from symmetrical faces are rated as healthier than those from less symmetrical faces, indicating that symmetry and skin condition may act as multiple cues to shared underlying health.

While facial symmetry and skin condition likely alter attractiveness as cues to health, the association between facial dimorphism and attractiveness is less clear.

Femininity correlates with attractiveness in female faces. The link between attractiveness and masculinity in men's faces is less certain. It is possible that facial masculinity in men's faces acts a sexually-selected trait indicative of an individual's ability to overcome high levels of testosterone, an immunosuppressant (Folstad & Karter, 1992). The link between masculinity and health is supported by relatively few studies, however (Rhodes et al., 2003; Thornhill & Gangestad, 2006), and more recent studies indicate that face preferences are more heavily based on cues to cortisol than testosterone (Moore et al., 2011a; 2011b). One recent study found that facial masculinity did not mediate the relationship between immunocompetence and attractiveness; rather that facial adiposity was a significant mediator of these factors (Rantala et al., 2013). It is important to note, however, that facial masculinity is a stable face trait, which could have been much more strongly related to health before the advent of modern medicine (Little 2012).

Facial masculinity has a clear and established association with perceived and actual measures of physical dominance (as discussed in Chapter 1). It is possible, and indeed likely, that facial masculinity has had historical impact on mating success through both intrasexual and intersexual selection. For example, men with masculine faces are perceived as more dominant, thus those men would stand relatively unopposed in gaining access to women. At the same time, women may prefer masculinity due to the heritable genetic benefits or resource holding potential that masculine faces connote.

The four components of attractiveness discussed in this chapter have been the subject of many empirical studies. While averageness, symmetry, skin condition and facial dimorphism are undoubtedly important aspects of attractiveness, it is likely there are other facial cues that also contribute. For example, body height and weight affect an individual’s attractiveness (as will be described in Chapters 4 and 5). Thus it is possible that facial characteristics associated with body height and weight also affect attractiveness. Chapter 1 described how facial cues to height and weight have received relatively little attention from face researchers. No empirical research has assessed how facial cues to height affect attractiveness, and while some studies have now been published on the relationship between facial adiposity and attractiveness, these findings need to be supported and expanded upon. To this end, Chapters 4 and 5 will present studies examining whether facial cues to perceived height and weight impact facial attractiveness.

Chapter 3: Facial cues to perceived leadership ability

3. The effects of facial appearance on leadership selection

Group leadership was essential for survival during early human evolution (van Vugt, Hogan, & Kaiser, 2008) Thus, the need for strong leadership in early human groups may have led to a style of social organization based on a single dominant leader (van Vugt et al., 2008). The psychological literature examining the traits that make a good leader is substantial. Although definitions of leadership vary by context (Kaiser, Hogan, & Craig, 2008), it is generally agreed that leaders have a large impact on their organization's success. (Barney, 1991; Barrick, Day, Lord, & Alexander, 1991; Bertrand & Schoar, 2003). Estimates of the effect that executive leadership has on the success of an organization are as high as 20-45% (Day & Lord, 1988; Thomas, 1988). Indeed, assessing the leadership abilities of others is such an important skill that people have developed the ability to make accurate judgments of leadership from faces after seeing them for only 1/10th of a second (Olivola & Todorov, 2010).

Martin (1978) was among the first to examine how faces could influence actual voting behaviour. Martin (1978) showed 33 Australian university student newspaper photographs of 11 political candidates and asked them to cast hypothetical votes on the faces alone. The hypothetical votes accounted for over 49% of the variance in the actual election votes, demonstrating that first impressions of facial appearance do have a strong impact on real-world voting behaviour. These results marked the beginning of a field of literature on how facial appearance influences hypothetical and real-world democratic leadership selection.

3.1. Facial attractiveness and leadership selection

Several studies have examined the role of facial attractiveness in leadership judgments. The earliest of these comes from Efran and Patterson (1974), who asked naïve participants to rate the attractiveness of 79 candidates for Canadian Parliament. Though participants were unaware that the facial photographs were of politicians, ratings of physical attractiveness correlated with votes obtained, providing the first empirical link between rated attractiveness and real-world electoral success.

Budesheim and Depaola (1994) were the first to assess how facial attractiveness influenced hypothetical leadership decisions when other, seemingly more relevant information was available. They reasoned that facial attractiveness should only influence perception of leadership candidates in the absence of information about candidates' personalities or their stance of political issues. They used forced-choice assessments comparing pictures of attractive and unattractive men alongside descriptions of personality and political viewpoints. The results of their studies indicated that facial attractiveness had a great effect on how much participants agreed with the fictitious candidates, with attractive candidates being rated as more agreeable than unattractive ones. Furthermore, this pattern held even in conjunction with favourable or unfavourable information about the candidate's personality. Most intriguingly, however, is that facial attractiveness reduced the influence of whether participants agreed with the candidate on political issues in whether they rated that candidate as a good leader. That is, information on facial attractiveness diminished how much participants relied on political platforms when making leadership judgments. More than that, facial attractiveness affected participants' perceptions of how similar a candidate's viewpoints were to their own, with participants finding their viewpoints more similar to an attractive candidate than an unattractive one. The results of Budesheim and Depaola (1994) highlight the importance of facial appearance in leadership decisions, and demonstrate how facial attractiveness can diminish or override candidate information relevant to a particular election.

Surawski and Ossoff (2006) tested whether facial attractiveness had an effect on perceived leadership ratings. They found that 90 undergraduate participants rated attractive faces as better leaders than unattractive faces (and that facial attractiveness had a relatively larger impact on leadership ratings than vocal attractiveness). This study used actual photographs of male politician's faces that were pre-rated for attractiveness and asked participants to simply rate perceived leadership ability. It is worth noting that this study, as well as Budesheim and Depaola (1994) only used male faces as stimuli, believing that politics was a primarily male field and that attractiveness may affect male and female electoral candidates differently.

Three further studies found that facial attractiveness related to electoral success in real-life political elections. Banducci, Karp, Thrasher and Rallings (2008) had participants rate the attractiveness of ballot photographs of political candidates from "low-information elections" (elections in which there was very little campaigning and nearly no media coverage). They found that rated attractiveness predicted electoral success independent of physical traits including sex, age and ethnicity (though the effect of attractiveness was significantly reduced when entered in a model with trait evaluations including trustworthiness, leadership ability, qualification, competence, and experience). King and Leigh (2009) collected attractiveness ratings of political candidates in the 2004 Australian House of Representatives election. Attractiveness ratings were collected from Australian and American raters to eliminate any bias from knowing the candidates. King and Leigh (2009) found that a one standard deviation increase in attractiveness ratings was associated with a 1.4% increase in votes obtained, a significant result that they argue is politically salient given the number of close elections in Australian politics. A third study was conducted in Finland by Berrgren, Jordahl and Poutvaara (2010), using Finnish politicians at the municipal and parliamentary level. The politicians' faces were rated for attractiveness by non-Finnish participants (in order to keep anonymity). In this study, a one standard deviation increase in attractiveness ratings was associated with a 17% increase in votes for municipal candidates and a 20% increase for parliamentary candidates. Facial attractiveness was correlated with votes obtained for incumbents, non-incumbents, female and male politicians. These three recent studies indicate that facial attractiveness has a significant effect on real-world politics in today's society.

Little, Roberts, Jones and DeBruine (2012) were the first to experimentally manipulate facial attractiveness to determine its effects on voting behaviour. They first had participants rate 83 male faces for facial attractiveness, trustworthiness (how trustworthy a person appears from their face), masculinity and votability. A linear regression found that attractiveness and trustworthiness had significant independent effects on voting behaviour. In a second experiment, the 15 faces rated most/least attractive and trustworthy were digitally averaged together to create face prototypes, and 5 synthetic faces were then transformed to increase and decrease attractiveness and trustworthiness (these transform methods are common in face perception research and are used extensively throughout Chapters 4-9; please refer to those chapters for more details). Participants were then presented with forced-choice trials presenting two versions of a face, one manipulated to be more attractive/trustworthy and one manipulated to be less attractive/trustworthy. Participants were significantly more likely to vote for the more attractive/trustworthy face. Little et al. (2012) expanded upon these findings by testing face preferences for leaders in different social contexts. They repeated their forced-choice task, this time asking participants to choose the best leader in a time of war or a time of peace as done in a previous experiment (Little, Burriss, Jones, & Roberts, 2007). When differentiated by social context, they found that participants were more likely to choose the more attractive face in a time of war, but not a time of peace, whereas participants chose the more trustworthy face in a time of peace, but not a time of war. These results were replicated after ensuring the face prototypes used in transformation did not overlap in attractiveness and trustworthiness attributions (that is, attractiveness prototypes did not vary in perceived trustworthiness and vice versa). Little et al. (2012) hypothesize that attractiveness is preferred in a war context as it is indicative of health, and perceived health has been found to be influence voting behaviour (Kramer, Arend, & Ward, 2010), while other attributions, such as trustworthiness, may take priority when social context is less strained. The effect of social context on leadership choice is further explored in Chapter 9.

3.2 Facial dominance /competence/power and leadership selection

The role of facial appearance on voting behaviour has been the focus of many empirical studies in the last decade. Todorov, Mandisodza, Goren and Hall (2005) tested the effects of perceived facial competence on electoral success in U.S. Senate and House of Representative elections in 2002 and 2004. Their studies presented black and white photographs of the winners and the first runner up for 321 Senate and 279 House elections (setting up a forced-choice decision) and asked participants to simply choose the person they thought was most competent. The candidate thought to be most competent looking won 71.6% of the Senate elections and 66.8% of the House elections. Furthermore, in a regression analysis, competence judgments were found to be the only accurate predictor (β=0.49, $p<0.01$) alongside the age of the candidates, attractiveness, and familiarity. This study was extended to U.S. gubernatorial (governor) races by Ballew and Todorov (2007), who again found that judgments of competence predicted electoral outcomes in 68.5% of 89 elections from 1995-2002 (faces of highly familiar governors were removed from this study). Interestingly, participants' ratings of competence predicted governor elections more accurately when they were given only 250ms to glance at the photographs (picking the winning candidate as more competent in 68.5% of trials), as opposed to when they were given unlimited time (62.9%). This finding demonstrates that "thin-slice" first impressions of candidates' appearance have a great influence on actual voting behaviour. This study was extended even further, to predicting the 2008 U.S. presidential election (Armstrong, Green, Jones, & Wright, 2010). In this study, participants rated potential U.S. presidential candidates on competence long before the party primaries and before participants were familiar with the faces (participants were mostly from universities and high schools in Australia and New Zealand). The faces chosen most competent from each party (Hilary Clinton for the Democrats, and John McCain for the Republicans) won the total popular vote for their party (though Barack Obama, who was rated nearly as competent as Clinton, won the democratic nomination via delegate voting). Competence ratings also predicted the presidential election, as Obama was rated more competent than McCain. These results demonstrate that facial appearance has an effect on voting behaviour even in the highest levels of government.

While ratings of competence and dominance are predictive of electoral success in western countries, little research has been done to examine how these ratings affect perceived leadership ability in other cultures. Rule et al. (2010) examined how American and Japanese participants evaluated American and Japanese politicians. They had 133 faces of American political candidates from the 2006 US Senate race and 122 faces from a 2000 Japanese political race. Leadership preferences differ across these cultures (Americans prefer strong, dominant leaders, whereas the Japanese prefer more reserved types; Den Hartog, House, Hanges, & Ruiz-Quintanilla, 1999). Both American and Japanese participants rated the American and Japanese faces for perceived dominance, facial maturity, likability and trustworthiness. A principal components analysis (PCA) found that competence, dominance and maturity all loaded onto one factor (which they called "power") while likability and trustworthiness loaded onto another (which they called "warmth"). Both Japanese and American participants showed agreement ratings of power and warmth across both face ethnicities. Unsurprisingly, power ratings made by both American and Japanese participants predicted the American politicians' electoral success. However, power ratings did not predict electoral success for Japanese politicians; instead, ratings of warmth were significantly predictive. This indicates that perceived power (sometimes interchangeably referred to as dominance or competence) is only predictive of electoral success in western cultures. Furthermore, when asked to judge what politicians would be successful in an election only same-culture ratings were accurate (Americans participants predicted success in the American election and Japanese predicted success for the Japanese election). There was evidence of self-projection when participants tried to make judgments across cultures, in that American participants rated the most powerful-looking Japanese politicians as the best leaders and Japanese participants rated American politicians with high “warmth” rating to be the best leaders. This paper is highly influential, as it demonstrates that judgments of perceived leadership ability may be accurate within cultures, but vary by cultural leadership preferences.

Recent studies in the business world have also found that ratings of facial competence in leaders in the business world correlate with actual profit. Rule and Ambady (2008) collected facial photographs of the Chief Executive Officers (CEOs) for the top 25 and bottom 25 ranked companies from the 2006 Fortune 500 website. The faces were rated for perception of leadership, competence, dominance, maturity, likability and trustworthiness. As in Rule et al. (2010) competence, dominance and maturity were combined into a “power” factor, while likability and trustworthiness were loaded onto a “warmth” factor. Leadership ratings were kept independent of these two factors. Rule and Ambady (2008) found that judgments of leadership predicted company profits when controlling for facial attractiveness, age and emotional affect. Furthermore, the power factor significantly predicted company profits independently of leadership ratings, suggesting that leadership and power ratings are not inherently the same. This study was the first to show that not only do facial cues to perceived leadership ability predict electoral success, but they also correlate with real-world leadership success, at least as is measured by company profits.

Rule and Ambady followed this study with the first paper to examine leadership perception solely in female leaders’ faces. Rule and Ambady (2009) expanded their search to the Fortune 1000 to use the faces of the 20 female CEOs in the list. Similar to the findings in male faces, ratings of leadership ability predicted company profits for female faces. Competence judgments also predicted company profits when facial attractiveness, age and emotional affect were controlled (no PCA was conducted to create a "power" factor in this study, unlike Rule and Ambady, 2008). These findings are similar to those found for men's faces (Rule & Ambady, 2008). This study is particularly important as it focused on female faces, a demographic largely ignored in the previous literature. Most research on facial cues to perceived leadership ability had used only men's faces since men make up most leadership roles, and some authors claimed what is preferred in a male leader's face may not be preferred in a female leader, since men and women have different leadership styles (Lauterbach & Weiner, 1996). Rule and Ambady (2009) demonstrated that judgments of leadership ability and competence independently predict company profits for female leaders as they do for male leaders, indicating that facial cues to leadership ability work similarly across both sexes. Given this knowledge, both men's and women's faces are used as stimuli throughout the empirical research reported in Chapters 6-9.

Further to their work in the business world, Rule and Ambady (2011a) examined how judgments of power (this time again PCA factor combining ratings of competence, dominance and maturity) in law firm Managing Partners (MPs) predicted firm profits. Firms were chosen from American Lawyer's top 100 law firms, and much like the CEOs of Fortune 1000 companies, ratings of power of MPs' face were predictive of company profit. This study is important, as leadership roles in law firms rely much more on within-company promotion, whereas business CEOs can and often are hired from outside the company. Face judgments of leadership therefore not only predict leadership success in the corporate world, but indicate an ability to "rise to the top" of the corporate ladder.

Facial width-to-height ratio (fWHR) was discussed as a cue to dominance and aggression in Chapter 1. Just as some studies have reported links between fWHR and dominant behaviour, two studies have found that fWHR is associated with leadership performance. Wong, Ormiston and Haselhuhn (2011) measured fWHR of 55 male CEOs from Fortune 500 organisations between 1996 and 2002. They found that fWHR correlated with their companies financial gains (controlling for company size, baseline profits before the CEO was in power, etc.). They found a caveat to this finding, in that the relationship between CEO's fWHR and company profit was only significant if the company had a cognitively simple leadership hierarchy (i.e. – the CEO has absolute leadership, instead of a more complex leadership structure; Hermann, 1999). The latter finding indicates that the dominant behaviour associated with high fWHR may be a more valuable leadership tool when the leader has greater control over their organisation.

Correlations between high fWHR and dominant behaviour are well-documented (Carre & McCormick, 2008; Carre et al., 2009; Stirrat & Perrett, 2010). One study found that fWHR is also associated with achievement drive in United States (US) presidents (Lewis, Lefevre, & Bates, 2012). In a sample of 29 frontal images of former US presidents, fWHR correlated with ranked "achievement drive" (as previously defined by Simonton, 1986), while negatively correlating with "poise and polish." These findings align with research on fWHR and dominant and aggressive behaviour, and reiterate the fact that facial cues to dominance and leadership are relevant even at the highest levels of government. Facial width-to-height ratio has been found to correlate with real measures of dominant behaviour and leadership ability. Chapter 7 will examine how fWHR influences perceptual ratings of leadership ability.

Previous studies have examined whether facial cues to perceived leadership ability are predictive of success in either political elections or corporate profits. Since most photographs that were rated for competence or leadership ability were taken from current politicians of business leaders, it was unclear whether these cues occur naturally, or whether they develop with the pressure and strain of becoming a leader. Rule and Ambady (2011b) examined this by collecting the college yearbook photographs of 73 of the law firm MPs used in Rule and Ambady (2011a). College photographs were taken anywhere from 20 to 50 years prior to the current day photographs used in Rule and Ambady (2011a). The college yearbook photographs were rated for power (once again comprised of dominance and maturity ratings) and warmth (comprised of likability and trustworthiness). Power and warmth ratings from the college photographs correlated to the ratings of the current day MPs. Power ratings once again predicted law firm profits and warmth did not, as was the case for ratings from the current day MP photos (Rule & Ambady, 2011a). This study indicates that facial cues to perceived leadership ability (referred to as "power" in this study) are consistent across time, and are not developed through experience.

As discussed in the previous section, facial attractiveness is differentially preferred in leaders' faces based on social context (Little et al., 2012). Social context also affects preferences for facial dominance in leaders' faces. Little et al. (2007) conducted a two-part study to examine how face shape influences voting behaviour. In the first part, they created face prototypes of winning and losing candidates for national leadership races of several countries, including the UK, US, Australia and New Zealand (i.e. Tony Blair and William Hague from the 2001 British national election; Helen Clark and Jenny Shipley from the 1999 New Zealand national election). They then transformed composite faces ±50% towards the faces shape of the winner (and 50% away from the loser) and, separately, 50% towards the face shape of the loser (50% away from the winner). Participants were presented with both versions of the transformed composite and asked which they would choose as a leader. Composites transformed towards the prototype of the winning candidate (defined as the candidate who won popular vote in the real-life election) “won” the participants vote 57% of the time, demonstrating that candidates who win real-world leadership votes have a more “leader-like” face shape.

In the second part of Little et al. (2007) assessed how changing face shape to enhance leadership appearance affects perception of personality traits. They transformed composite faces ±50% on a dimension between George Bush’s face and John Kerry’s face (the winner and loser of the 2004 US federal election). Participants then voted in a forced-choice task for either the “plus-Bush” (anti-Kerry) face or the “plus-Kerry” (anti-Bush) face. Furthermore, these faces were separately rated for seven perceived traits: attractiveness, masculinity, dominance, strong leader, likability, forgivingness, and intelligence. They found that the plus-Bush face was perceived as more masculine and dominant while the plus-Kerry face was perceived as more likable, attractive and intelligent. The plus-Bush face was perceived as the stronger leader, and was selected by more people as the person they would choose to run the country (these last two effects were not statistically significant, but the authors posit that even small effects could influence elections if the trends hold true in real life).

Little et al. (2007) tested whether preferences for the plus-Bush/plus-Kerry faces were affected by social context. They asked participants to vote for the faces either under a context of war or a context of peace. They found that the plus-Bush face gained

74% of the vote under a war context, while the plus-Kerry face received 61% of the vote in the peace context. Furthermore, Little et al. created a 50% masculinity transform (described in Chapters 1 and 2) of the same base composite and had participants vote for the masculinized or feminized version. Participants voted for the masculinized face 64% of the time in the war context, while the feminized face received 60% of the vote in the peace condition. The differing results found under war and peace contexts suggest that, much like in preferences for actual politicians, preferences for potential leaders' appearance is affected by social circumstances. The theories tested by Little et al. (2007) and (2012) form the basis for the experiments detailed in Chapter 9.

Recent studies have further examined the role of social context in face preferences for leaders. Spisak et al. (2011) masculinized and feminized base composites by 30% and paired them with either competitive statements about group competition (it's us versus them…) or cooperative statements about working together with another group ("We should work together with the [other] group…). Participants were then asked to rate the leader qualifications of the faces. Masculinized faces with competitive statements and feminized faces with cooperative statements were rated as better leaders than masculinized/cooperative and feminized/competitive combinations. A further study indicated that participants expected leaders with masculinized faces to behave more competitively and leaders with feminized faces to behave more cooperatively. These results are in line with van Vugt and Spisak (2008), who found that male leaders are preferred during times of intergroup competition while female leaders are preferred in times when maintenance of within-group relations is emphasized (i.e. civil unrest). van Vugt and Spisak (2008) theorize that preferences for masculine leaders are enhanced during intergroup conflict because men are typically more aggressive and competitive than women, and men adopt a hierarchical leadership style (Eagly & Johnson, 1990), and have historically been more active in group battles (Goldstein, 2003; Keegan, 1994). Women, on the other hand, adopt a more egalitarian and communal leadership style that is better suited for maintaining peace (Eagly & Johnson, 1990; Goldstein, 2003).

Spisak et al. (2012) conducted another study on social context and face preferences for leaders. They replicated the results of Spisak et al. (2011) by finding that masculinized faces are preferred as leaders more in an intergroup conflict context while feminized faces are preferred more in a group maintenance context. They extended these findings by discovering that such preferences occur in both Western (British) and East Asian (Indonesian and West Timorian) participants. These results indicate that preferences for dominant-looking leaders in inter-group conflict settings extend beyond western cultures, perhaps reflecting a deeper cognitive preference for aggression towards group threat.

3.3 Summary

Face judgments of leadership ability have predicted experimental and real-world leader selection, and correlate with leadership success in the business world. It is clear from the research described in this chapter that perceived leadership ability is influenced by both facial attractiveness and perceived dominance. These two factors have accounted for a great deal of variance in experimental voting behaviour and are advantageous to actual leader candidates.

While previous studies have revealed clear relationship between attractiveness and dominance and leadership judgments, research in this area could be expanded.

Attractiveness and dominance are both perceptual judgments, and with the exception of masculinity (Little et al., 2007), no studies have established quantifiable face dimensions that influence perceived leadership ability. While perceptual correlations are useful, they require participants to rate faces for social attributions and do not allow researchers to predict perception of leadership ability from measurable face dimensions.

Body height and weight have significant effects on perceived dominance and attractiveness. Body stature also influences leadership perception (as will be discussed throughout Chapters 6-9). Given the association between body stature and perceived leadership ability, it is possible that facial cues associated with body height and weight contribute to leadership selection as well. To this end, Chapters 6-9 will examine how facial cues associated with perceived body height and weight influence judgments of leadership ability.

Overview to Experimental Chapters

As described in Chapter 3, facial cues to attractiveness and physical dominance play large roles in leadership judgments. My own experimental research will focus on how two facial cues to physical body size – perceived height and facial adiposity – influence perceived attractiveness, dominance, and leadership ability.

Chapters 4 will report findings on an empirical study examining how facial cues to perceived height (how tall someone appears to be from facial images) alter attractiveness. Chapter 4 considers the role of own height in establishing individual differences in attraction to facial cues of height in a partner. Chapter 5 will examine how facial adiposity alters perceived facial attractiveness, including how this effect is shifted by visual exposure to heavy and light body types.

Once the effects of perceived height and facial adiposity on facial attractiveness are determined, I will examine how these aspects of facial structure affect perceived leadership ability. Chapter 6 will report findings on the differences between the level of facial adiposity that maximizes attractiveness and the level that optimizes perceived leadership ability. This chapter will introduce the theoretical role of perceived dominance on leadership choice. Chapter 7 will present a large study on the role of perceived height in leadership choice, and will include a section on how facial cues to height are morphologically distinct from those to facial dimorphism.

Chapters 8 and 9 extend upon the findings of Chapters 6 and 7. Chapter 8 will examine both cues to perceived height and facial adiposity and the role they play on leadership choice in three-dimensional images of faces. Chapter 9 will detail a study on the role of social context (voting in times of peace and war) in how facial cues to perceived height affect leadership judgments, and will compare the effects of perceived height and masculinity on perception of facial dominance.

Chapter 4: Concordant preferences for actual height and facial cues to height

This chapter is based on research that has been published in a peer-reviewed journal:

Re D.E., Perrett D.I. (2012) Concordant preferences for actual height and facial cues to height *Personality and Individual Differences* 53, 901-906.

Abstract

Physical height has a well-documented effect on human mate preferences. In general, both sexes prefer opposite-sex romantic relationships in which the man is taller than the woman, while individual preferences for height are affected by a person's own height. Research in human mate choice has demonstrated that attraction to facial characteristics, such as facial adiposity, may reflect preferences for body characteristics. Here, we tested preferences for facial cues to height. In general, increasing perceived height in men's faces and slightly decreasing perceived height in women's faces maximizes perceived attractiveness. Men's and women's individual preferences for facial cues to height were predicted by self-reported preferences for actual height. Furthermore, women's own height predicted preferences for facial cues to perceived height, though this finding didn't extend to male participants. These findings validate the use of facial cues to height and demonstrate a further component of facial attractiveness that reflects preferences for body characteristics.

4.1 Introduction

Physical height has a well-documented impact on human social interaction. Taller people obtain greater career success in the business world (Judge & Cable, 2004) and are more often promoted to positions of authority (Gawley, Perks, & Curtis, 2009). On average, taller men obtain a higher education (Magnusson, Rasmussen, & Gyllensten, 2006) and taller men and women earn a higher average income than their shorter counterparts (Meyer & Selmer, 1999; Rashad, 2008; Steckel, 1983). Taller men are more likely to ascend to positions of political leadership (McCann, 2001; Murray & Schmitz, 2011; Sorokowski, 2010), and successful political candidates are judged to be taller after winning an election than beforehand (Higham & Carment, 1992). The link between height and career success may be explained by personality correlates of height. Taller members of both sexes have higher reported self-esteem (Judge & Cable, 2004), and behave in a more dominant manner (Melamed, 1992), and tall men report more frequent acts of aggression (Archer & Thanzami, 2007). Consistent with these personality traits, taller people are perceived as stronger, smarter and more dominant (Cawley, Joyner, & Sobal, 2006; Montepare, 1995). The association between height and conflict success is even present in preverbal infants, who show more surprise when taller vertical lines back away from shorter lines in computer simulations (Thomsen et al., 2011).

Just as height influences social status, it also has an impact on mate choice (Courtiol, Raymond, Godelle, & Ferdy, 2010). Both men and women prefer romantic relationships in which the man is taller than the woman (Courtiol et al., 2010; Higgins, Zheng, Liu, & Sun, 2002; Jackson & Ervin, 1992; Pawlowski, 2003; Salska et al., 2008). Women prefer taller men (Shepperd & Strathman, 1989) in general, though perhaps not extremely tall men (Courtiol et al., 2010; Hensley, 1994). Taller men receive more interest from women in personal advertisements (Pawlowski & Koziel, 2002) and are rated as more desirable in speed-dating events (Kurzban & Weeden, 2005). Men's preferences for women's heights are less clear, with various studies reporting male preferences for short (Shepperd & Strathman, 1989), average height (Swami et al., 2008), or taller than average (Courtiol et al., 2010) women. Previous research has demonstrated assortative preferences for height, with height preferences being influenced by a person's own height (Fink, Neave, Brewer, & Pawlowski, 2007; Mcmanus & Mascietaylor, 1984; Pawlowski, 2003; Salska et al., 2008; Swami et al., 2008), and taller women and shorter men are more tolerant of dating partners their own height (i.e. - prefer a lower "sexual dimorphism in stature"; Pawlowski, 2003). Further research has demonstrated that women have stronger preferences for tall men during the fertile phase of their menstrual cycle (Pawlowski & Jasienska, 2005), and that women's height preferences in men are positively predicted by conformity to views on traditional gender roles and positively correlate with personality traits such as self-esteem and extraversion (Swami et al., 2008). Consistent with reported height preferences, there is some evidence that taller men (Mueller & Mazur, 2001; Pawlowski, Dunbar, & Lipowicz, 2000), and short (Devi, Kumari, & Srikumari, 1985) or average height women (Mueller, 1979; Nettle, 2002; Vetta, 1975) have greater reproductive success than people of other heights, though these effects are not replicated in all studies. See Sear (2010) and Stulp, Pollet, Verhulst, & Buunk (2012) for a full review of studies on height and reproductive success.

Human mate preferences are also influenced by facial attractiveness. As Chapter 2 summarised, facial attractiveness is dependent on several face parameters, including masculinity, symmetry, averageness and skin colour and texture. Recent research has uncovered elements of facial attractiveness related to body characteristics. Male facial attractiveness has been found to positively correlate with body attractiveness (Fink, Taschner, Neave, Hugill, & Dane, 2010), and grip strength (Fink, Neave, & Seydel, 2007). Facial adiposity correlates with actual and perceived body mass index (BMI) (Coetzee et al. 2010; Coetzee et al., 2009), and altering apparent BMI in faces presented in isolation affects attractiveness (Coetzee et al., 2011; Re et al., 2011). Such findings indicate that some components of facial attractiveness may reflect preferences for body characteristics.

Craniofacial research indicates that stature may be estimated from skull shape, and face growth occurs coincidentally with body growth (Akgul & Toygar, 2002; Enlow & Hans, 1996; Ramanathan & Chellappa, 2006), with taller men having longer faces with narrower jaws (Windhager et al., 2011). While height affects the preferred vertical location of features within a face (i.e. – taller people prefer faces with large foreheads and small chins, simulating the view of a face as seen from above; Geldart, 2008), no studies have reported how face cues to perceived body height influence perceived attractiveness. Thornhill and Grammer (1999) found correlations between independent ratings of attractiveness in women's bodies and faces, suggesting the two domains act as a single ornament of quality, though the correlations were relatively low (face and frontal view of body, r=.30; face and back view of body, r=.33). Conversely, Peters, Rhodes and Simmons (2007) found that face and body attractiveness did not interact in judgments of overall attractiveness, and Honekopp, Rudolph, Beier, Liebert and Müller (2007) found men's physical fitness correlates with body attractiveness, but not face attractiveness. These results indicate that faces and bodies are separate cues to attractiveness. Other studies have demonstrated that the face has a relatively greater impact than the body in judgments of overall attractiveness (Currie & Little, 2009; Mueser, Grau, Sussman, & Rosen, 1984; Peters et al., 2007), though this has not been replicated in all studies (Alicke, Smith, & Klotz, 1986). Together, these studies indicate face and body cues have independent effects on overall attractiveness, thus the effect of cues to height in the face should be analysed independently of actual body height.

Here, we assessed whether preferences for facial cues to height reflected explicit height preferences. Furthermore, we examined whether preferences for facial cues to height are assortative based on own height, similar to the assortative preferences in body height reported elsewhere (Salska et al., 2008; Swami et al., 2008). Based on previous research on actual height preferences (Courtiol et al., 2010; Jackson & Ervin, 1992; Pawlowski, 2003; Salska et al., 2008; Shepperd & Strathman, 1989), we predict women will prefer faces of men who appear to be taller than average, and men will prefer faces of women who appear to be short to average height. We expect preferences for height cues in the face to reflect self-reported preferences for actual height. Finally, we predict preferences for facial cues to perceived height will correlate with an individual's own height.

4.2 Methods

4.2.1 Face stimuli

We presented participants with Caucasian face images of 47 men (mean age=25.25 years, SD=4.64 years, mean body mass index (BMI)=24.10 kg/m^2, SD=3.52 kg/m^2, 4 with partial beard) and 83 women (mean age=23.04 years, SD=3.81 years, mean BMI=20.05 kg/m^2, SD=4.12 kg/m^2) that were obtained from a commercially available database of face images (available at www.3d.sk.com). All photographed individuals had their hair pulled back and were photographed under constant lighting and camera set-up. Face images were standardized for inter-pupillary distance. All faces were delineated with 189 points with custom face-processing software (Tiddeman et al., 2001). Men's heights ranged from 168 cm to 192 cm (mean=179.72 cm, SD=6.43 cm), and women's heights ranged from 156 cm to 184 cm (mean=167.58 cm, SD=6.33 cm). Twenty-two participants (11 men, 11 women) were asked to "please rate how tall you think this person is in either feet and inches or cm" and were given eight evenly spaced height divisions from 152 cm to 203 cm (5'0"–6'8"). The average perceived height for women's faces was 167.52 cm (SD=3.08 cm), while the average perceived height for men's faces was 179.71 cm (SD=3.03 cm), and inter-rater reliability was high for height ratings of both men's and women's faces (Cronbach's $\alpha \geq 0.94$).

Face composites were created for experimental testing. Face composites were created by averaging three male or female faces together (Rowland & Perrett, 1995), and reflected the average height of the population. Using face composites reduces the likelihood of possible facial anomalies that may confound experimental testing. Five male and five female face composites were created to use for testing.

We averaged the faces of the 10 people who were perceived as shortest and the 10 people perceived as tallest within each sex (referred to as 'perceived height prototypes'). The short female prototype had an perceived height of 162.9 cm, while the tall female prototype had an perceived height of 172.2 cm. The short male prototype had an perceived height of 175.7 cm, while the tall male prototype had an perceived height of 183.8 cm.

Each composite was transformed to simulate changes in perceived height. We created face shape continua of 20 steps for each composite by applying ±100% of the shape difference between the perceived height prototypes of the same sex (Rowland & Perrett, 1995). This created face continua of 20 images spanning from 100% 'perceived short' shape to 100% 'perceived tall' shape in 10% increments for each composite (see Figure 4.1 for an abbreviated example). A validation task was conducted to ensure our perceived height transforms did in fact alter perceived height. Twenty-two participants (16 women, 6 men) were presented with individual images of two male and two female

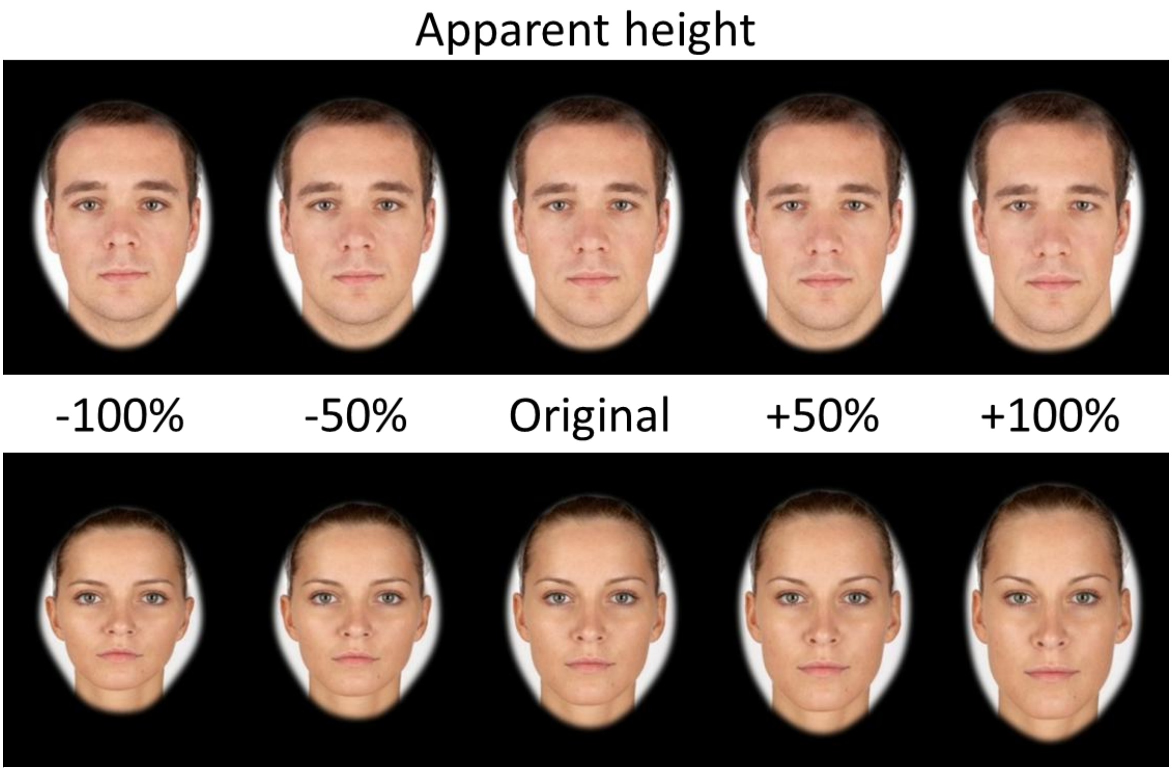

Figure 4.1. Abbreviated examples of male and female perceived height transforms. Each continua contained 20 images spanning ±100 in perceived height in 10% increments. Original images, ±50% and ±100% transforms are shown. Participants were allowed to manually transform to any image in the continua to maximize attractiveness.

composites transformed ±50% in perceived height. Participants were asked to rate how tall each person was on a scale of 1 (extremely short) to 7 (extremely tall). Paired-samples t-tests revealed that the composites increased in perceived height were rated as taller than those decreased in perceived height for both women's and men's faces (both $t(21) \geq 5.07$, both $p<0.01$).

4.2.2 Procedure

One hundred and forty-seven women and 61 men (mean age=24.72, SD=10.56, 84.1% White European) completed the study online. Participants filled out a survey to report sex, age, height, and preferred height of partner. All height questions could be reported in either feet and inches or centimetres in a drop-down menu of 1 cm increments from 136 cm (4'5") to 212 cm (7'0"). Participants who reported an own height or preferred height of less than 147 cm (4'10") were later excluded from analysis, as this value is a typical height criterion for dwarfism (U.S. National Library of Medicine, 2012).

The ten face transform continuums (five male and five female composites) were presented to the participants individually and in random order. A custom interactive program was created to allow participants to change face shape. Scrolling over the face would individually present consecutive images within a continua, giving the effect that participants were "manually" changing the face shape. Participants were instructed to scroll over the face to manually transform the shape and asked to "Please change the face to make it most attractive". The starting degree of transformation of the face was randomized, and the scroll direction was randomized, (i.e. – scrolling to one side of the face would not always make the face appear taller). Such interactive tests have been successfully used in previous face research (Little, Jones, Penton-Voak, Burt, & Perrett, 2002; Perrett et al., 1998).

4.2.3 Analysis

First, the average degree of transform required to maximize attractiveness in male and female faces was calculated, and we tested for differences between participant sexes. The perceived heights (in cm) of the prototypes used in the perceived height transforms were known, thus we were able to convert the change in perceived height required to maximize attractiveness from degree of transform (in percentage) to theoretical centimetres. Next, two multivariate ANCOVAs were run to test for the effects of preferred height and own height on degree of face transform.

4.3 Results

On average, male participants slightly reduced perceived height in female faces by 1.89% (0.20 cm; SD=27.19%) to maximize attractiveness, while female participants slightly reduced perceived height in female faces by 6.09% (0.59 cm; SD=26.50%). Male participants increased perceived height in male faces by 21.15% (1.71 cm; SD=32.97%) to maximize attractiveness, while female participants increased perceived height in male faces by 15.32% (1.24 cm; SD=32.38%). One sample t-tests showed that, across all participants, women's faces were reduced in perceived height more than would be expected by chance ($t(207)=-2.63$, $p<0.01$, Cohen's $d=0.37$), and men's faces were increased in perceived height more than would be expected by chance ($t(207)=7.54$, $p<0.01$, Cohen's $d=1.05$; Figure 4.2). A one-way ANOVA found no differences between participant sex in the degree of transform for female ($F(1,207)=1.07$, $p=0.30$, $\eta_p^2<0.01$) or male ($F(1,207)=1.38$, $p=0.24$, $\eta_p^2=0.01$) faces.

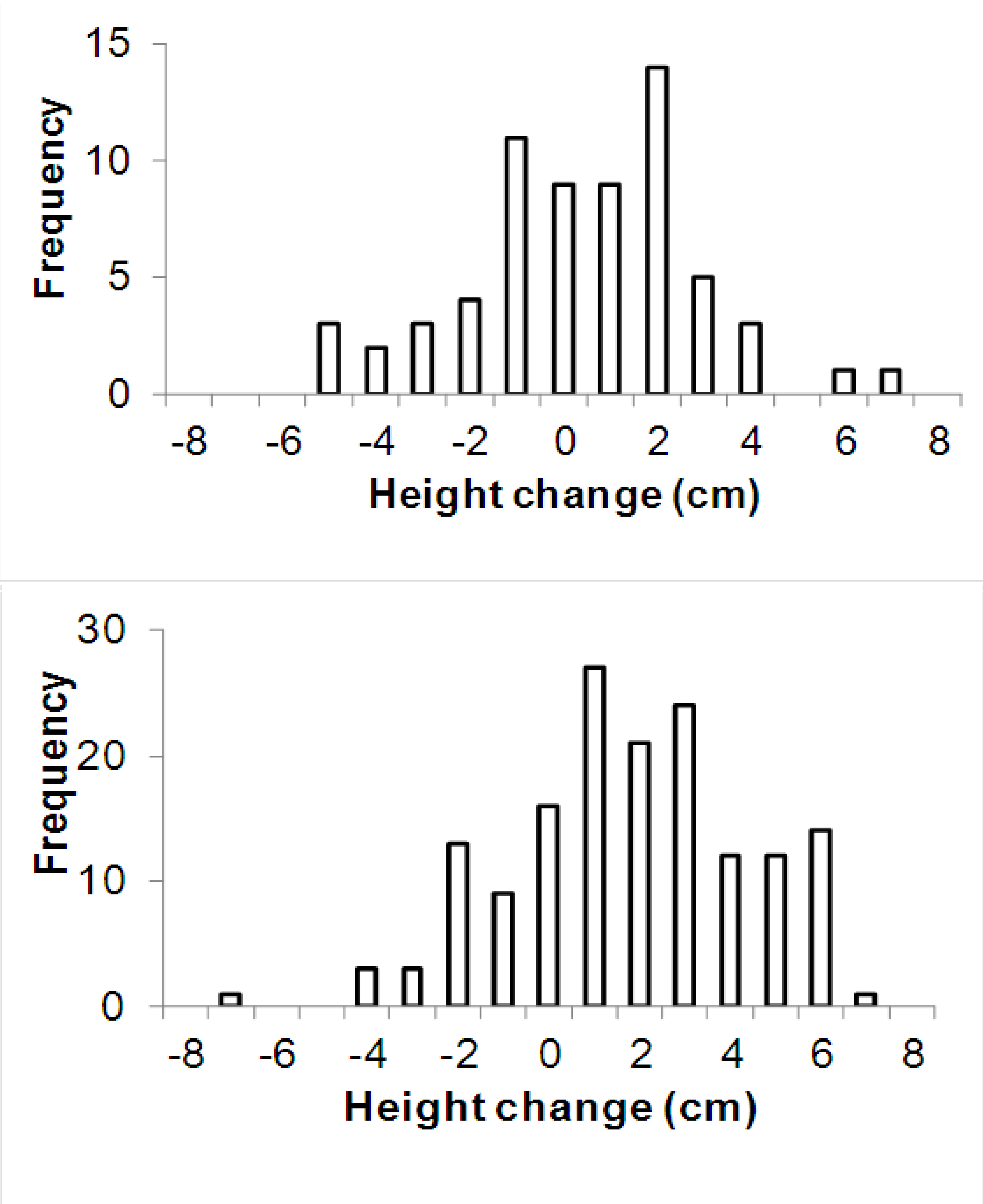

Figure 4.2. Histograms illustrating changes made in perceived height (in cm) to maximize attractiveness for men viewing women's faces (top) and women viewing men's faces (bottom).

Multivariate ANCOVAs were run to test for the effect of participant's own height on perceived height preferences in male and female faces. For female participants, own height had an effect on perceived height preferences for male faces ($F(1, 145)=4.37$, $p=0.04$, $\eta_p^2=0.03$; Figure 4.3, top left), with taller women preferring greater perceived height in male faces. Women's own height did not have an effect on perceived height preferences for female faces ($F(1, 145)=0.07$, $p=0.79$, $\eta_p^2<0.01$). For

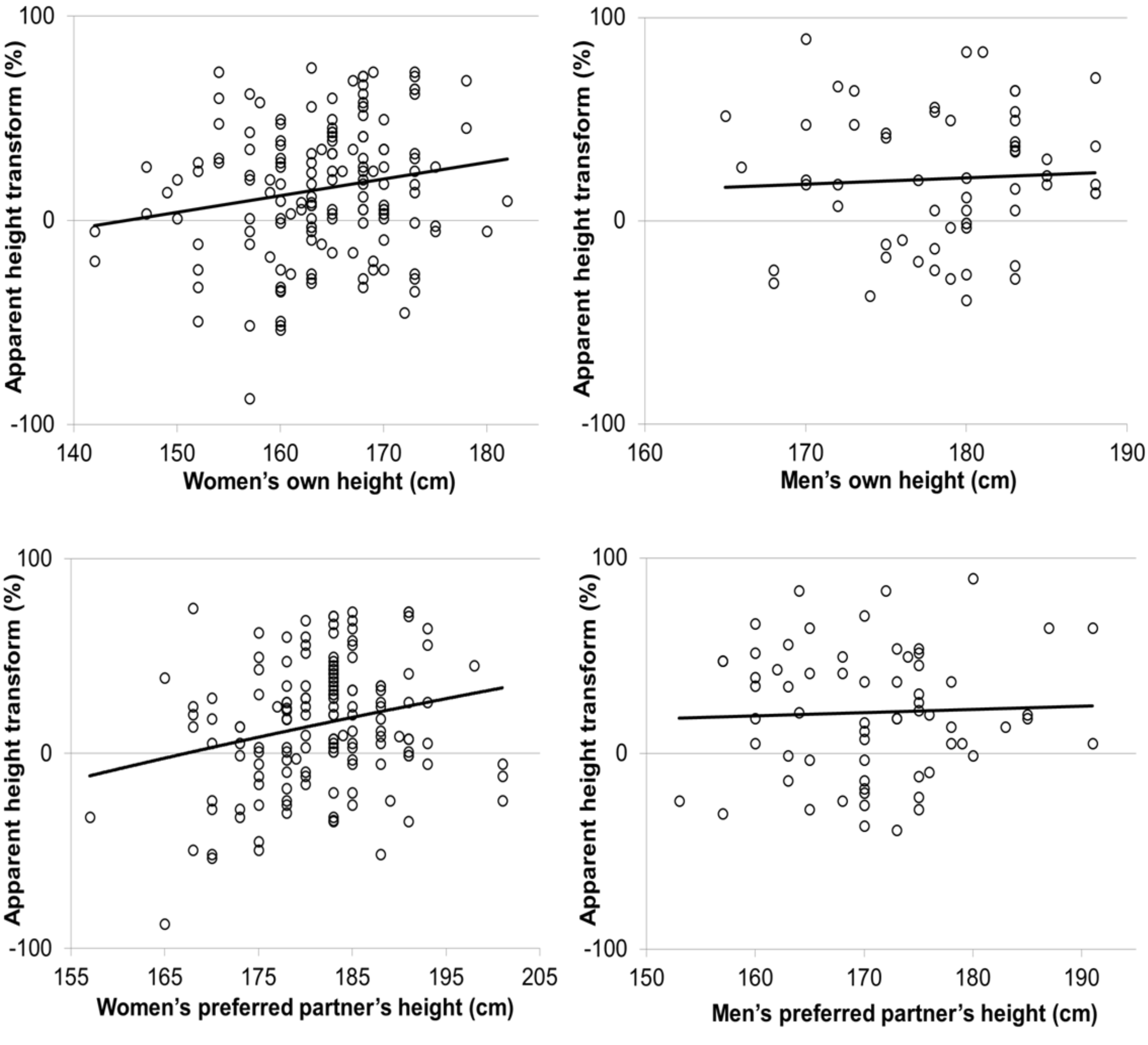

Figure 4.3. Scatterplots showing the relationship between women's and men's own height (top row) and reported preferred height in a partner (bottom row) on the perceived height transform to maximize attractiveness for opposite-sex faces for female (left) and male (right) participants.

male participants, own height did not have an effect on perceived height preferences for female ($F(1, 59)=0.70$, $p=0.41$, $\eta_p^2=0.01$; Figure 4.3, top right) or male ($F(1, 59)<0.01$, $p=0.99$, $\eta_p^2<0.01$) faces.

Multivariate ANCOVAs were run to test for the effects of reported preferred height in partners on degree of perceived height transform. For female participants, reported height preferences for partners predicted degree of perceived height transform in male faces ($F(1, 145)=9.26$, $p<0.01$, $\eta_p^2=0.06$; Figure 4.3, bottom left), but not female faces ($F(1, 145)=0.44$, $p=0.51$, $\eta_p^2<0.01$). For male participants, reported preferred height in partners predicted degree of perceived height transform in female faces ($F(1, 61)=5.62$, $p=0.02$, $\eta_p^2=0.09$; Figure 4.3, bottom right), but not male faces ($F(1, 61)=0.12$, $p=0.73$, $\eta_p^2<0.01$).

4.4 Discussion

The current study finds that, from an average height, people prefer women's faces that are slightly reduced in perceived height, and prefer men's faces that are increased in perceived height. These results mirror those found for preferences of actual physical height (Higgins et al., 2002; Jackson & Ervin, 1992; Pawlowski, 2003; Salska et al., 2008; Shepperd & Strathman, 1989). Furthermore, the degree of transform that participants used to maximize facial attractiveness was predicted by their reported preference for height in a partner.

It should be noted that the average perceived height for men's faces in our sample was 179.71 cm, while the average perceived height for women's faces was 167.52 cm. We found that an average increase in perceived height of 1.37 cm for men's faces and a reduction of 0.47 cm for women's faces maximized attractiveness.

Theoretically, this produces most attractive perceived heights of 181.08 cm and 167.05 cm for our population. While 181 cm is certainly taller than the average man in the vast majority of western countries, including the United States (www.cdc.gov) and the United Kingdom (www.ic.nhs.uk), 167 cm is also slightly taller than the average western female, though slightly shorter than the average female used in our sample. Thus, while relative trends in preferences for perceived height in faces (taller than average in men, average or slightly shorter than average in women) mirror explicit height preferences (Pawlowski, 2003; Salska et al., 2008; Shepperd & Strathman, 1989), preferences for absolute height may be population specific.

Height preferences have been found to be assortative based on own height (Pawlowski, 2003; Salska et al., 2008; Swami et al., 2008). In the current experiments, women's own height predicted preferences for perceived height in men's faces. Conversely, men's own height did not predict preferences for perceived height in women's faces. Previous research has demonstrated that women place greater importance on height as a mate choice cue than men and that men are more tolerant of the idea of dating women taller than themselves, perhaps as a way to increase their potential mating pool (Salska et al., 2008). The current results indicate that this trend is upheld in preferences for face cues to perceived height. It should be noted that women increased perceived height in men's faces only by about 15% (out of a range of ±100%; or 1.24 cm out of a possible 8.08 cm), which may mirror attenuated preferences for extremely tall height in men (Courtiol et al., 2010; Hensley, 1994).

Previous research has found that height preferences are influenced by individual differences. Women show a greater preference for tall men when in the ovulatory period of their menstrual cycle and when choosing a partner for a short-term relationship

(Pawlowski & Jasienska, 2005). Furthermore, preferences for greater sexual dimorphism in stature between two partners correlates with views conforming to typical sex roles, and personality attributes such as self-esteem, neuroticism and extraversion (Swami et al., 2008). Further research could test whether preferences for perceived height in the face are influenced by such individual differences. Given the alignment between the current results and those found for studies on physical height preferences, we predict any factor that affects physical height preferences will also affect preferences for facial cues to perceived height.

Body and face stimuli have independent effects on overall attractiveness judgments (Peters et al., 2007). Here, we find that preferences for face cues to perceived height match preferences reported in the body height literature. While the relative impact of face cues to height and actual body height on attractiveness are not known, several studies have found that faces have a greater effect on attractiveness judgments than bodies (Currie & Little, 2009; Mueser et al., 1984; Peters et al., 2007). It is therefore likely that face cues to perceived height would impact perceived attractiveness even when presented alongside actual body height.

The current experiments reveal that preferences for facial cues to perceived height align with preferences for actual height reported elsewhere. Face preferences reflect preferences for body size in other domains, such as body weight (Coetzee et al., 2011). Our study finds that manipulating faces to alter perceived height can affect judgments of facial attractiveness.

Chapter 5: Viewing heavy bodies enhances preferences for facial adiposity.

This chapter is based on research that has been published in a peer-reviewed journal:

Re, D., Coetzee, V., Xiao, D., Buls, D., Tiddeman, B.P., Boothroyd, L.G. & Perrett, D.I. (2011). Viewing heavy bodies enhances preferences for facial adiposity. Journal of Evolutionary Psychology, 9, 295-308

Abstract:

Experience-dependent changes in mate choice preferences may confer an evolutionary benefit by shifting preferences towards traits that are advantageous for specific environments. Previous studies have demonstrated that prolonged exposure to one type of face biases perceptions of subsequently viewed faces and exposure to one type of body biases perceptions of subsequently viewed bodies. We tested whether preferences in facial adiposity were affected by viewing heavy or light bodies. We first assessed facial adiposity preferences by asking Caucasian participants (n=59) to transform three-dimensional female Caucasian faces along a body mass index (BMI) continuum until they reached optimal attractiveness. Participants then viewed heavy- or light-bodied two-dimensional images with the faces cropped out before repeating the face preference task. Male and female participants who viewed heavy bodies shifted preferences toward significantly higher facial adiposity, while those who viewed the light bodies showed no significant overall shift. These results provide evidence that adaptation to certain body types affects subsequent preferences for facial adiposity, and suggest that adaptation to one body domain may affect preferences in other body domains.

5.1 Introduction

Experience at different periods of development can modify mate choice preferences to suit local environments. One way that experience may influence preferences is through ‘after-effects’ that occur with prolonged exposure to particular stimuli (DeBruine et al., 2007; Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). For example, facial after-effects occur when prolonged exposure to faces leads to biased perceptions of subsequently viewed faces. They occur despite up to 16-fold increases in image area (Anderson & Wilson, 2005; Zhao & Chubb, 2001), as well as orientation changes up to 90º (Rhodes, Jeffery, et al., 2003; Rhodes et al., 2004; Watson & Clifford, 2003) and changes in retinal position up to 6º (Kovacs, Cziraki, Vidnyanszky, Schweinberger, & Greenlee, 2008; Leopold, O'Toole, Vetter, & Blanz, 2001). Face-after-effects are also category-contingent, and have been found to be specific to the sex (Bestelmeyer et al., 2008), ethnicity, and age (Little, DeBruine, Jones, & Waitt, 2008) of the face being adapted to.

Adaptation to human stimuli is not limited to faces. Winkler and Rhodes (2005) found that viewing heavy bodies biased subsequent perception of body normality and attractiveness. Glauert et al. (2009) found that women with higher body dissatisfaction were less prone to after-effects after adapting to heavy bodies, suggesting body after-effects are affected by higher-order cognitive functions such as body satisfaction. Furthermore, emerging evidence suggests that after-effects may be possible with pictures of bodies of heavier women depicted in a positive setting (Boothroyd, Tovee, & Pollet, 2009).

Adaptation to faces and bodies may serve an evolutionary function. Face and body attractiveness may provide indicators of mate quality (Fink & Penton-Voak, 2002;

Rhodes, 2006; Thornhill & Grammer, 1999). Criteria for mate quality differ by culture and environment, as is reflected in cross-cultural variation in perception of attractiveness. For example, masculinity preferences for male faces vary with culture and geographical region (DeBruine, Jones, Crawford, et al., 2010; DeBruine, Jones, Little, Crawford, & Welling, 2011; Penton-Voak et al., 2004). Likewise, high BMI is preferred in resource-scarce cultures, whereas much lower BMI bodies are preferred in resource-abundant cultures (Swami & Tovee, 2007). Preferences for BMI even differ among people of the same culture who live in areas of different resource abundance (Tovee, Swami, Furnham, & Mangalparsad, 2006). Plasticity in mate choice preferences is advantageous for selecting mates suitable for a given environment, and may reflect an evolved flexibility in preferences or the impact of learning on mate selection. Shifts in preferences could also reflect after-effects produced by visual exposure to norms of a given environment. The current study assessed whether adaptation to one mate-choice domain (bodies) affected subsequent preferences in a different domain (faces).

Mate choice judgments and assessment of intrasexual rivals are based on a variety of cues to an individual's quality (Candolin, 2003). The diversity of cues requires conjoint processing for simultaneous evaluation to reconcile potential trade-offs between signals of quality from different domains. Given assessments of attractiveness for separate body domains are consolidated to produce overall attractiveness judgments (Candolin, 2003), we may therefore expect visual adaptation of one cue (e.g. from bodies) to affect perception of other cues (e.g. from faces). Indeed, adapting to bodies of a particular sex does bias subsequent perception of sex-ambiguous faces toward the opposite sex (Ghuman, McDaniel, & Martin, 2010). By contrast, face after-effects are not produced after adaptation to stereotypically gender-specific objects such as football helmets, purses, etc. (Ghuman et al., 2010) or human hands (Kovacs et al., 2006). These findings suggest that ‘cross-adaptation’ can occur for human mate choice stimuli (such as faces and bodies), but not for all types of stimuli.

Several studies have evaluated the timecourse of adaptation to faces. After-effects may reflect a variety of neural mechanisms lasting over different time scales, from seconds to days (reviewed in Barraclough & Perrett, 2011). Rhodes et al. (2007) found a logarithmic build-up and exponential decay for facial after-effects, much like those found in low-level visual after-effects that last for only a few minutes (Harris & Calvert, 1989; Krauskopf, 1954). By contrast, Webster et al. (2004) and Carbon and Leder (2006) present data consistent with long-lasting after-effects in face perception. Moreover, Carbon et al. (2007) found that adaptation to distorted familiar faces can produce after-effects more than 24 hours later. If visual adaptation serves an evolutionary function, we would expect long-lasting (i.e. – more than a few minutes) after-effects such as the ones reported elsewhere (Carbon & Leder, 2006; Carbon et al., 2007; Webster et al., 2004), which may affect perception of subsequently-viewed mate choice stimuli.

Recent studies have found that facial adiposity, or perception of weight from faces, plays an important role in perception of health and attractiveness (see Chapter 1). Coetzee, Perrett and Stephen (2009) had participants rate faces for weight and found that such facial adiposity ratings correlated with actual BMI of the photographed individuals. More importantly, facial adiposity also predicted perceived health and attractiveness, with faces of average adiposity being rated as healthy and attractive and ratings decreasing for very low or high adiposities. Furthermore, facial adiposity correlated with actual measures of respiratory and cardiovascular health. Indeed, adiposity is one of several traits influencing attractiveness that is correlated across the face and body (Gangestad & Thornhill, 2003; Hume & Montgomerie, 2001; Thornhill & Grammer, 1999).

In the present study, we tested whether or not body size would produce after-effects in preferences (preference after-effects) for facial adiposity. If adaptation crosses attractiveness cues, exposure to heavy or thin bodies should produce visual after-effects in the perceived attractiveness of faces with different facial adiposities. Specifically, we predict that adaptation to heavy bodies would produce preferences for higher facial adiposity, and adaptation to thin bodies would produce preferences for lower facial adiposity. We also tested if after-effect strength was affected by the elapsed time between adaptation to bodies and the subsequent face preference task. If adaptation plays a role in mate choice, we would predict after-effects to be relatively long in duration and to diminish little over time of testing.

5.2. Materials and Methods

5.2.1 Stimuli

We recruited 96 female Caucasian participants (age: mean = 20.4, range = 18 – 28; BMI: mean=22.9, range = 17.8 – 35.1) from the University of St Andrews. Each participant's height and weight were measured directly and used to calculate BMI ((weight in kilograms)/(height in metres)^2) using a Tanita SC-330 body composition analyser (Tanita, Holland). The face of each individual was captured with a three-dimensional face scanner (www.3dmd.com), which provides a surface map of the 3-D structure and surface colouration (Figure 5.1). Once captured, the images can be rotated to show faces from different angles. All photographed individuals posed with their hair pulled back, and were asked to maintain a neutral expression.

Figure 5.1. Three-dimensional face images, shown from centre-view and left and right half profiles for faces with low facial adiposity (top row, BMI=18), medium facial adiposity (middle row, BMI=22), and high facial adiposity (bottom row, BMI=26). The faces were rotated from side to side to show the entire 3D structure.

Thirty-eight facial landmarks were manually defined on each captured face image. The facial landmarks were used as a basis for averaging and transforming (using custom built software: Morph-Analyser; Perception Lab) in an equivalent manner to that used for two-dimensional face image processing (Blanz & Vetter, 1999; Rowland, Perrett, Burt, Lee, & Akamatsu, 1997; Tiddeman et al., 2001). Individual three-dimensional face shapes can be combined together to create a facial surface representative of a set of individuals. To achieve this, surface maps for each captured face are first re-sampled to a standard face. This step establishes an equivalent number of depth samples between corresponding facial landmarks in any two faces; in effect it establishes the correspondence between locations over the entire surface of all faces in the image collection. Depth values for corresponding loci on the facial surfaces can then be averaged across component individuals. Maps for the colouration of the facial surface can be separately averaged, and wrapped into alignment with the average surface maps. For the experiment, we first created two faces to use as 'prototypes' (averages of low and high facial adiposity for women) for use in subsequent transformations of target faces. Each prototype was made by averaging 10 individual images. The low-adiposity prototype was made of 10 faces of women with low BMIs (mean = 18.3, range: 17.8 – 18.8), and the high-adiposity prototype was made from participants with high BMIs (mean = 29.9, range: 27.5 – 35.1). We then created composite images by averaging three individual same-sex faces. The composites of women's faces were created as stimuli to be manipulated by participants in the experiment. Composites were used to eliminate any structural or textural outlier that may be apparent in any individual image, as well as to eliminate the risk of participant recognition of any particular face. The four female composites had average BMIs of

18.0, 21.9, 25.4 and 32.5. Multiple composites were used in the experiment to avoid any confounds that could occur by using one particular stimulus. To test for facial adiposity preferences, a program was used that allowed participants to manipulate the adiposity of the composite face images. Participants were shown a composite face and could move a slider that transformed the 3-D shape by applying up to 150% of the difference between heavy and light prototypes. Participants could increase or decrease the BMI of the composite faces by 17.4 kg/m^2. This occurs by taking the points on the composite face and moving them by the difference of the corresponding points on the prototype faces. The process is again similar to the transformation used in two-dimensional face manipulation software (Tiddeman et al., 2001), used in studies of face preferences (Perrett et al., 1998). The three-dimensional images were rotated 30º from side to side at 25º a second, allowing participants to use motion parallax to perceive the 3-D surface shape of the front and sides of each face without stereo-viewing glasses (Figure 5.1).

Images of thin female models or 'plus-sized' female models were used for adaptation. The images, originally full length photographs, were cropped so the faces were not shown. Two conditions were created, one showing participants images of 21 plus-sized models (referred to as the "heavy condition"; UK body size ~14-16), and the other showing images of 25 regular models (referred to as the "light condition"; UK body size ~4-6). Though the exact BMI of these models was unknown, it is clear that the plus-sized models, by definition, have much higher BMIs than the thin models. Images of bodies were taken from a variety of websites showing thin and plus-sized models. The images varied in terms of position within frame, posture, perspective view (profile, front), and type of clothing (e.g. – bikini, full-length dress, etc.). All models were oriented with their heads toward the top of the screen (models were standing except two in the heavy condition - one sitting and one lying down). The vertical height of the images ranged from visual angles of 18º to 72º. The body stimuli were loosely controlled in order to assess whether BMI itself affected face preferences. Visual after-effects occur after viewing simple shapes (Regan & Hamstra, 1992), thus displaying body images in various positions and orientations eliminated the possibility that simple body shape (round, elliptical, etc.) would produce after-effects in face preferences. Such body stimuli have been used successfully in previous adaptation studies (Boothroyd et al., 2009).

5.2.2 Participants

We recruited fifty-nine (43 women, 16 men) Caucasian undergraduate students (age: mean = 20.32, range = 18 – 26) from the University of St Andrews, Scotland, to perform the interactive adiposity preference and adaptation tasks for course credit. All participants gave informed consent.

5.2.3 Procedure

Each participant was first tested on an interactive facial adiposity preference test. They then proceeded to the adaptation task before being retested on the preference test. Each of the four composites was shown in the preference task at the same size (vertical length: 13º) and rate of rotation, and was presented three times in pseudo-randomised order. Each participant saw each composite three times, thus each participant manipulated twelve faces. Participants were presented with composite 3-D faces one at a time and asked to “Please manipulate the face until you think it is most attractive”. Participants then completed the adaptation task in which they viewed either the heavy or light conditions.

Thirty-two participants (9 males, 23 females) viewed the light condition, and 27 (7 males, 20 females) viewed the heavy condition. The design was between-subjects, as participants viewed only either the heavy or light condition. The light condition consisted of 25 body images, and the heavy condition consisted of 21 body images, both repeated twice. Participants were asked to identify whether each body belonged to a person of Asian or Caucasian ethnicity as a distracter task to ensure they were naïve to the purpose of the body images.

After viewing the body images, participants were asked to repeat the facial adiposity preference manipulation task. Composites were shown at the same size and rotation rate as the first task, and order was again randomised.

Analysis:

We defined preference after-effects (change in facial adiposity preferences before and after adaptation to bodies) as the difference between BMI represented by adiposity preference after adaptation and the BMI preference before adaptation.

To compute an overall effect of adaptation to bodies we measured the preference after-effects in the expected direction (i.e. increasing preference after adapting to heavy bodies and decreasing preference after adapting to light bodies).

5.3 Results

Before adaptation, the mean facial adiposity preferred across all evaluators represented a BMI of 19.6 (SD=2.3). Preferences were not significantly different between male and female evaluators ($t(57)= -0.64$, $p=0.52$).

Overall, adaptation to bodies (in the heavy and light conditions) produced preference after-effects that were significantly different from zero ($t(58)=2.19$, $p=0.03$).

This suggests that exposure to bodies altered subsequent preferences for facial adiposity.

Participants who viewed the heavy condition showed a shift in preferences towards higher facial adiposity, representing an average BMI of 20.1 (SD = 2.7). This is equivalent to an increase of 0.5 BMI units after adaptation to heavy bodies (Figure 5.2). A matched pair t-test showed that the pre- and post-adaptation BMI preferences were significantly different ($t(26)=-2.26$, $p=0.03$). The differences between pre- and post-adaptation preferences were not significantly different between male and female evaluators ($t(25)=-0.40$, $p=0.69$), though the low number of males in the heavy condition (7) should be noted.

Participants who viewed the light condition showed a mean facial adiposity preference that represented a BMI of 19.5 (S.D. = 2.4); a slight but non-significant reduction from the pre-adaptation preferences ($t(31) = 0.80$, $p=0.43$). The differences between pre- and post-adaptation preferences were not significantly different between male and female evaluators ($t(30) = 0.93$, $p=0.36$), though again the low number of male participants (9) should be noted.

The shift between pre- and post-adaptation preferences were significantly different between the heavy and light conditions ($t(57) = -2.3$, $p=0.02$).

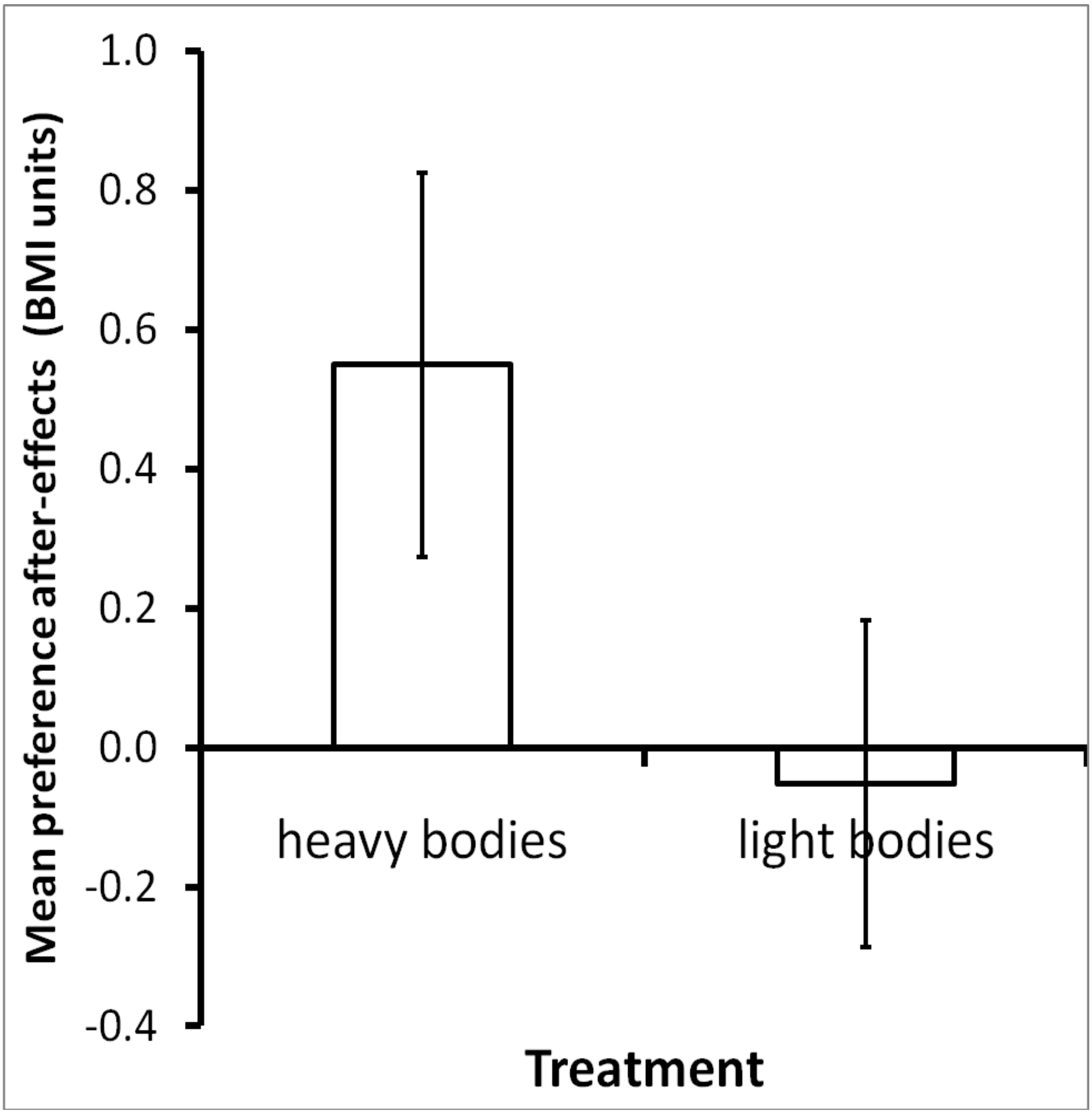

Figure 5.2. Mean preference after-effects after viewing light- and heavy-body conditions. Preference after-effects were calculated by subtracting post-body exposure facial adiposity preferences from pre-body exposure facial adiposity preferences.

We wanted to test if the strength of the after-effect was affected by order of presentation. If the after-effects have very short lifespans, there should be attenuation of after-effect strength for faces presented toward the end of the post-adaptation test phase. As there were 12 faces used for post-adaptation adiposity preferences, we grouped testing faces into the first six and last six faces presented after adaptation. A repeated-measures ANOVA found no differences in after-effect size between the first-six and last-six groups in either the heavy ($F(1,31)=0.06$, $p=0.94$) or light ($F(1,26) = 0.75$, $p=0.39$) conditions. Thus, the preference after-effects were not significantly affected by the order of face presentation. This demonstrates that the elapsed time (up to 7 minutes) between adaptation and testing did not alter after-effect strength.

5.4 Discussion

The results indicate that viewing bodies can alter attraction to facial adiposity. Participants preferred faces higher in facial adiposity after viewing heavy bodies. Reciprocally, participants preferred faces lower in facial adiposity after viewing light bodies, but this latter effect was not significant.

The BMI represented by the mean facial adiposity preference before adaptation (19.6) is in accordance with the optimal BMI of 19 – 20 found in previous studies of body preferences (Tovee & Cornelissen, 2001; Tovee, Maisey, Emery, & Cornelissen, 1999; Tovee, Reinhardt, Emery, & Cornelissen, 1998). This suggests that facial adiposity in three-dimensional images accurately represented BMI. Such an alignment in results helps cross-validate the different techniques and encourages further use of three-dimensional face image technology.

Adaptation to shapes has been shown to produce after-effects on the aspect ratios of test shapes; for example adapting to a horizontal rectangle may make a subsequently-viewed square appear to have a lower width-to-height ratio (Regan & Hamstra, 1992). The variations in body and face images in this study, however, extend beyond shape differences. Our body images not only varied in size, but also body posture, clothing, and view (frontal or side-view). Furthermore, the faces used for the preference task rotated from side to side, thus shape and width-to-height ratio of the face image changed throughout viewing. The after-effects also spanned from stationary two-dimensional body images to rotating three-dimensional faces. The high degree of variation in both face and body images makes it unlikely that after-effects are due to a low-level shape adaptation.

Body to face after-effects are expected if adaptation occurs in mechanisms involved in judgments of attractiveness, as overall attractiveness judgments require integration of multiple cues (Candolin, 2003). Face and body cues usually correlate with cues to mate quality from other domains, such as voice, movement and odour (Cornwell et al., 2004; Feinberg, DeBruine, Jones, & Little, 2008; Hume & Montgomerie, 2001; Rikowski & Grammer, 1999; Saxton, Burriss, Murray, Rowlands, & Roberts, 2009; Thornhill & Grammer, 1999), though they may be evaluated independently (Peters et al., 2007). Moreover, in assessment of individuals, cues to quality will often be in conflict with one another. In such cases, integration of information from different domains is needed for decisions regarding overall attractiveness. Our finding of cross-domain adaptation suggests neural integration of attractiveness cues.

Preferences for faces (DeBruine, Jones, Crawford, et al., 2010; DeBruine et al., 2011; Penton-Voak et al., 2004) and bodies (Swami & Tovee, 2007; Yu & Shepard, 1998) change from culture to culture which may allow the selection of particular phenotypes suited to specific environments. Cultural differences in preferences can arise through a variety of processes (e.g. imprinting, associative learning, mate choice copying). Preference after-effects may also be a further mechanism influencing selection that depends on an individual's experience within a culture and environment.

For body to face after-effects to be useful in an evolutionary sense, the adaptation must last long enough to view multiple bodies or faces. Several face (Zhao &

Chubb, 2001) and body (Glauert et al., 2009; Winkler & Rhodes, 2005) adaptation studies have presented their adapting stimuli between test trials to maintain after-effects. In the current study, all bodies used for adaptation were shown before subsequent test faces. Face after-effects follow a logarithmic build-up and exponential decay (Rhodes et al., 2007), but short exposures to distorted familiar faces can produce after-effects more than a day later (Carbon et al., 2007). There was no evident decay of after-effect strength during testing in the present study. Such results support the idea that body-face after-effects could be useful in the context of mate choice or intrasexual competition. Furthermore, in 'real-world' situations, viewing several bodies over time may 'update' adaptation and retain after-effects (Rhodes, Jeffery, et al., 2003).

Interestingly, whereas the heavy-body condition produced significant after-effects, the light-body condition did not. This is concordant with other evidence that adaptation-like effects of models' images are seen only for larger, not thin, models (Boothroyd et al., 2009), though this effect has not been found in other studies (Glauert et al., 2009; Winkler & Rhodes, 2005). One possible explanation for the lack of adaptation to light bodies is the female body images used in the light-body condition may have been similar to those frequently shown by the media (Gonzalez-Lavin & Smolak, 1995). Participants' preferences may have already been 'tuned' to light-bodied women before adaptation, due to frequent and glamorous portrayals of such bodies in the media, thus further presentation of these bodies may have had no effect. This would suggest that internalisation of thin-ideals presented in the media factors into preferences for women. If preferences were formed based solely on visual exposure, one would expect preferences for average-sized or overweight women, as they are much more frequently found in Western societies. Thin women are disproportionately represented in television media, however, with less than 10% of women on TV being overweight (Gonzalez-Lavin & Smolak, 1995), and exposure to such women affects women's ratings of self-attractiveness (Heinberg & Thompson, 1995; Thompson & Stice, 2001). It is possible that internalisation of thin-ideals may act to give thin women disproportionate influence on perceived body norms. Further research could be conducted on how cognitive biases affect after-effects for mate choice stimuli.

Although there were no differences in participant sex for the preference after-effects in this study, it should be noted that female faces and bodies were presented, and the majority of participants were female. Previous studies have demonstrated that men and women share similar attractiveness ratings for female faces (Fisher, 2004; Perrett et al., 1999; Perrett et al.,1998; Perrett et al., 1994) and female BMI (Tovee & Cornelissen, 2001). Sexual selection theory suggests women should be aware of the attractiveness of same-sex conspecifics, since intrasexual competition in women is based on perceived attractiveness (Buss & Dedden, 1990; Fisher, 2004). Indeed, ovulating heterosexual women buy "sexier" more revealing clothing when attractive, but not unattractive, women are in their environment, presumably as a form of intrasexual competition (Durante, Griskevicius, Hill, Perillioux, & Li, 2010). Thus, we have no reason to believe that after-effects produced using female face and body stimuli would be perceived differently by male and female participants, as both sexes are attentive to female attractiveness.

Further studies could assess how robust body-face after-effects are in terms of cues to mate quality. The current experiment investigates after-effects based on BMI and facial adiposity; it is possible these after-effects could translate to other body and face cues, as well. For example, exposing participants to muscular male bodies (Little, Jones, et al., 2007) could produce preference after-effects biased toward facial masculinity, as the two cues are related in terms of underlying testosterone (Neave et al., 2003; Penton-Voak & Chen, 2004; Roy et al., 2002). After-effects may span modalities and adapting to faces and bodies could affect preferences for voice pitch and vice versa (Feinberg, 2008; Feinberg, Jones, DeBruine, et al., 2005).

In summary, the current study explored changes in facial preference consequent to a visual diet of body images biased to be heavy or light in weight. Participants that viewed heavy bodies showed a subsequent preference for faces of higher adiposity. Hence, adaptation to mate choice stimuli seems to affect perception of related cues, which may reflect how multiple mate choice cues interact.

<u>Chapter 6: The effects of facial adiposity on attractiveness and perceived leadership ability.</u>

This chapter is based on research that is under peer-review in an academic journal:

Re, D.E., Perrett. D.I. (in revision). The effects of facial adiposity on attractiveness and perceived leadership ability.

Abstract

Facial attractiveness has a positive influence on electoral success in both experimental paradigms and in the real world. One parameter that influences facial attractiveness and social judgments is facial adiposity (a facial correlate to body BMI). Here, we used an interactive design in order to assess whether the most attractive level of facial adiposity is also perceived as most leader-like. We found that participants reduced facial adiposity more to maximize attractiveness than to maximize perceived leadership ability. These results indicate that facial appearance impacts leadership judgments beyond the effects of attractiveness. We suggest the disparity between optimal facial adiposity in attractiveness and leadership judgments stems from cultural trends that have produced thin ideals for attractiveness, while leadership judgments are associated with perception of physical dominance.

6.1 Introduction

Chapter 3 described how democratic leadership selection is influenced by leader candidates' facial appearance (Olivola & Todorov, 2010). For example, when asked to assess unfamiliar faces for leadership quality, naïve respondents will often pick the eventual winners of electoral decisions as better leaders than their political rivals. Ratings of leadership quality from face images have correlated with electoral success in many countries (Banducci et al., 2008; Buckley, Collins, & Reidy, 2007; Castelli, Carraro, Ghitti, & Pastore, 2009; Little, Burriss, et al., 2007; Martin, 1978; Rule & Ambady, 2010; Rule et al., 2010). Facial appearance also influences leadership success in the corporate world (Rule & Ambady, 2008, 2011a). The ability to rapidly evaluate leadership quality from faces may stem from a time where human groups were small and nomadic and leadership roles were associated with physical dominance (Murray & Schmitz, 2011; Riggio & Riggio, 2010). Assessments of leadership quality can be made after extremely brief (100ms) exposure to a face (Olivola & Todorov, 2010), similar to rapid assessments of physical dominance (Carre et al., 2009), and leadership judgments have been linked to the amygdala, phylogenetically one of the oldest parts of the human brain (Rule, Moran, et al., 2011; Schiller, Freeman, Mitchell, Uleman, & Phelps, 2009). Indeed, faces that look dominant and powerful have an advantage in leadership selection in both politics and business (Rule & Ambady, 2008, 2011a; Rule et al., 2010).

One body dimension that could influence perceived leadership ability is weight. The World Health Organization (WHO) defines body mass index (BMI; kilograms/meters^2) above 25 as overweight (World Health Organization, 2006). Overweight people often suffer professional discrimination (Rand & Macgregor, 1990) and are more likely to be of lower socioeconomic status (Sobal & Stunkard, 1989). Overweight people also suffer from lower self-esteem than people in a healthy weight range (Stunkard & Wadden, 1992). Previous research has demonstrated that body weight can be accurately judged from face images alone (Coetzee et al., 2010a). As demonstrated in Chapter 5, facial adiposity influences perceived attractiveness. Facial adiposity is a reliable cue of body BMI, and given the impact of BMI on social attributions, it is possible that face cues to BMI influence perceived leadership ability. It is unclear, however, how facial adiposity influences leadership judgments across a range of healthy, overweight and underweight BMI values.

Chapter 3 discussed how facial attractiveness has an effect on perceived leadership ability and leadership selection. Experimental studies have found that voters prefer leaders with attractive faces more in a war context than a peace context (Little et al., 2012). Judgments of leadership ability are especially influenced by facial attractiveness if little information is known about the candidates' political viewpoints (Riggle, Ottati, Wyer, Kuklinski, & Schwarz, 1992). Even with campaign information available, voters are likely to rely somewhat on social heuristics (Lodge, Steenbergen, & Brau, 1995) and are still influenced by facial appearance (Budesheim & Depaola, 1994), reinforcing the role of facial attractiveness on voting behaviour. Indeed, facial attractiveness has positively predicted electoral success in several countries (Banducci et al., 2008; Berggren, Jordahl, & Poutvaara, 2010; King & Leigh, 2009), cf (Mattes et al., 2010).

Given the link between attractiveness and leadership choice, it is possible that the level of facial adiposity found most attractive also maximizes perceived leadership ability. Alternatively, leadership judgments may be based in part on facial cues to physical dominance, making it possible that the levels of facial adiposity needed to maximize attractiveness and leadership perception are different. Here, we examine how facial adiposity influences attractiveness and perceived leadership ability. We will present participants with facial images and allow them to manipulate facial adiposity to maximize attractiveness, and separately, perceived leadership ability.

6.2 Methods

6.2.1 Stimuli

A database of 47 men's face and 83 women's faces were used to create the stimuli. All photographed individuals had their hair pulled back and were photographed under constant lighting and camera set-up. Face images were standardized for inter-pupillary distance. All faces were delineated with 189 points with custom face-processing software (Tiddeman et al., 2001).

Female and male face BMI prototypes were created. Twenty men and 20 women were matched for height. These groups were then separated into two groups of 10 based on weight. Male and female BMI prototypes were then created by averaging the 10 faces within each group, making a low and high BMI prototype for each sex. For the men's faces, the low BMI prototype had a mean BMI of 19.95 kg/m^2 (SD=1.08, range=17.71-21.14 kg/m^2; average age=21.40, SD age=2.50) and the high BMI prototype had a mean BMI of 28.39 kg/m^2 (SD=1.61, range=26.40-31.01 kg/m^2, average age=25.90, SD age=3.70). For the women's faces, the low BMI prototype had a mean BMI of 17.85 kg/m^2 (SD=0.80, range=16.82-19.37 kg/m^2, average age=22.70, SD age=3.56) and the high BMI prototype had a mean BMI of 24.06 kg/m^2 (SD=6.34, range=19.63-38.42 kg/m^2, average age=23.40, SD age=4.50).

Twenty face composites (10 male, 10 female) were created for experimental testing. Composites were created by averaging three male or female faces together (Rowland & Perrett, 1995). Using face composites reduces the likelihood of possible facial anomalies that may confound experimental testing.

Each face composite was transformed to simulate changes in BMI. We created face shape continua of 20 steps for each composite by applying ±100% of the shape difference between the BMI prototypes of the same sex (Rowland & Perrett, 1995). This created face continua of 20 images spanning low to high BMI (the exact BMI range varied by the starting BMI of each composite, but all transforms ranged from underweight to overweight; Figure 6.1). Similar methods were used in Chapter 5 to transform three-dimensional faces.

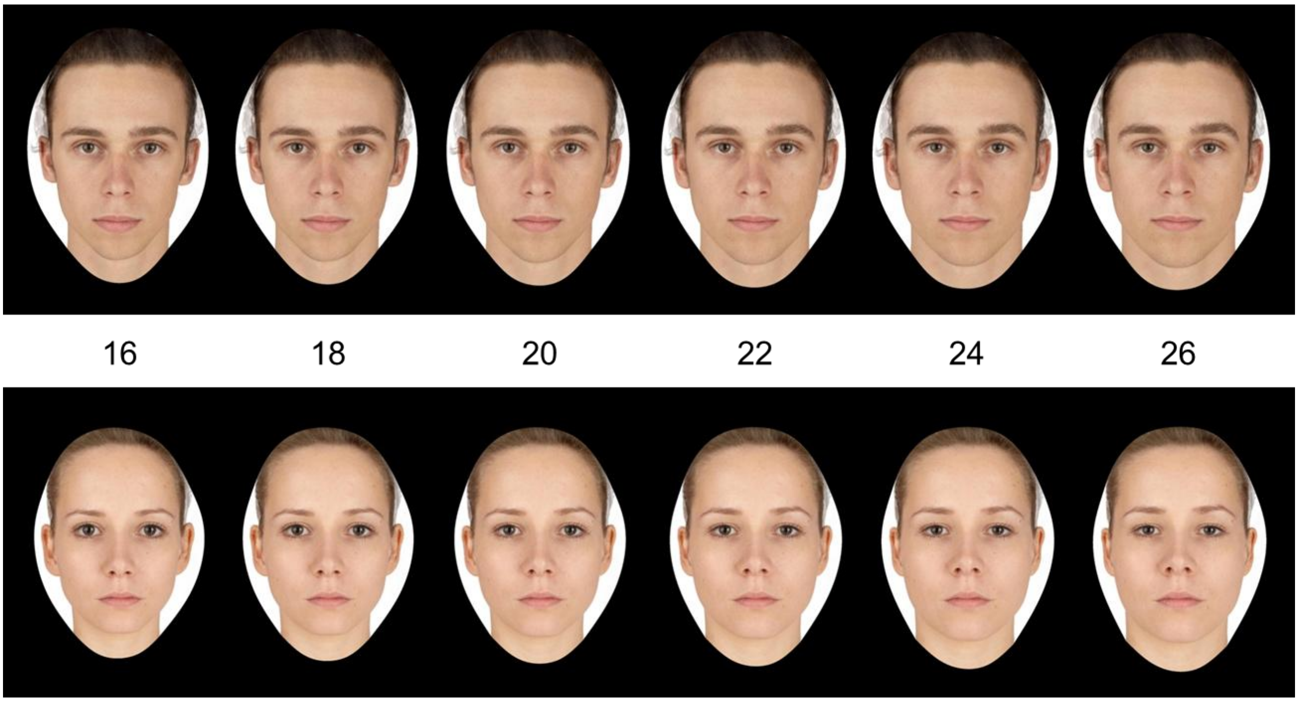

Figure 6.1. Selected examples of BMI transforms for a male and female composite. Body mass index values of 16, 18, 20, 22, 24, and 26 (all kg/m^2) are shown. Participants were asked to manipulate the composites to make the faces most attractive or most like a good leader.

6.2.2 Participants and procedure

One-hundred and ninety-one women and 95 men (mean age=27.01, SD=9.92, 86.7% Caucasian) completed an online experiment to maximize facial attractiveness. The 20 face transform continuums (ten male and ten female composites) were presented to the participants individually and in random order. A custom interactive program was created to allow participants to change face shape. Scrolling over the face would individually present consecutive images within a continuum, giving the effect that participants were "manually" changing the face shape. Participants were instructed to scroll over the face to manually transform the shape and asked to "please change the face to make it most attractive." The starting degree of transformation of the face was randomized, and the scroll direction was randomized, (i.e. scrolling to one side of the face would not always make the face appear heavier).

Nineteen women and 14 men (mean age=32.24, SD=12.30, 97% Caucasian) completed a similar interactive task online. These participants were presented with the ten male composites and ten female composites and were asked to "please make the face look most like someone you would think is a good leader."

Analysis:

The average degree of transform required to maximize attractiveness and leadership quality was calculated in male and female faces. The representative BMIs of the prototypes used in the BMI transform were known, thus we were able to calculate the simulated BMI from the face image chosen (as in Chapter 5).

6.3 Results

6.3.1 Attractiveness task

The degree of transformation required to maximize attractiveness was calculated for each face composite. Given the known BMI of the prototypes and original composites, we converted the degree of transformation to resultant BMI values. On average, female face composites were transformed to represent a BMI of 18.19 kg/m^2 (SD=1.66, range=15.89-21.45 kg/m^2) to maximize attractiveness (Figure 6.2). On average, male face composites were transformed to represent a BMI of 22.46 kg/m^2 (SD=1.87, range=20.60-26.60 kg/m^2) to maximize attractiveness. One-sample t-tests against chance (0% transformation) revealed that, on average, both female ($t(285)=-20.32$, $p<0.01$, Cohen's $d=2.41$) and male faces ($t(285)=9.32$, $p<0.01$, Cohen's $d=1.10$) were transformed to reduce BMI in order to maximize attractiveness.

A repeated-measures ANOVA revealed that female faces were transformed to represent a significantly lower BMI than male faces ($F(1,284)=996.52$, $p<0.01$, $\eta_p^2=0.78$). The sex of participant did not affect the transformation required to maximize attractiveness ($F(1, 284)=1.31$, $p=0.25$, $\eta_p^2=0.01$), nor was there an interaction between the sex of stimuli and sex of participant ($F(1, 284)<1.25$, $p=0.26$, $\eta_p^2<0.01$).

6.3.2 Leadership task

The degree of transformation required to maximize perception of leadership ability was calculated for each face composite and again converted to resultant BMI values. On average, female face composites were transformed to represent a BMI of 19.06 kg/m^2 (SD=1.76, range=16.67-22.12 kg/m^2) to maximize perception of leadership ability. On average, male face composites were transformed to represent a BMI of 23.59 kg/m^2 (SD=1.76, range=21.30-26.94 kg/m^2) to maximize perceived leadership ability. One-sample t-tests against chance (0% transformation) revealed that, on average, female faces were transformed to reduce BMI in order to maximize perceived leadership ability ($t(32)=-3.21$, $p<0.01$, Cohen's $d=1.13$). Male faces were not significantly transformed away from their original BMI in order to maximize perceived leadership ability ($t(32)=0.41$, $p=0.69$, Cohen's $d=0.14$).

A repeated-measures ANOVA revealed that female faces were transformed to represent a significantly lower BMI than male faces ($F(1,31)=111.53$, $p<0.01$, $\eta_p^2=0.78$). Sex of participant did not affect the transformation required to maximize attractiveness ($F(1, 31)=0.99$, $p=0.33$, $\eta_p^2=0.03$), nor was there an interaction between the sex of stimuli and sex of participant ($F(1, 31)<0.01$, $p=0.96$, $\eta_p^2<0.01$).

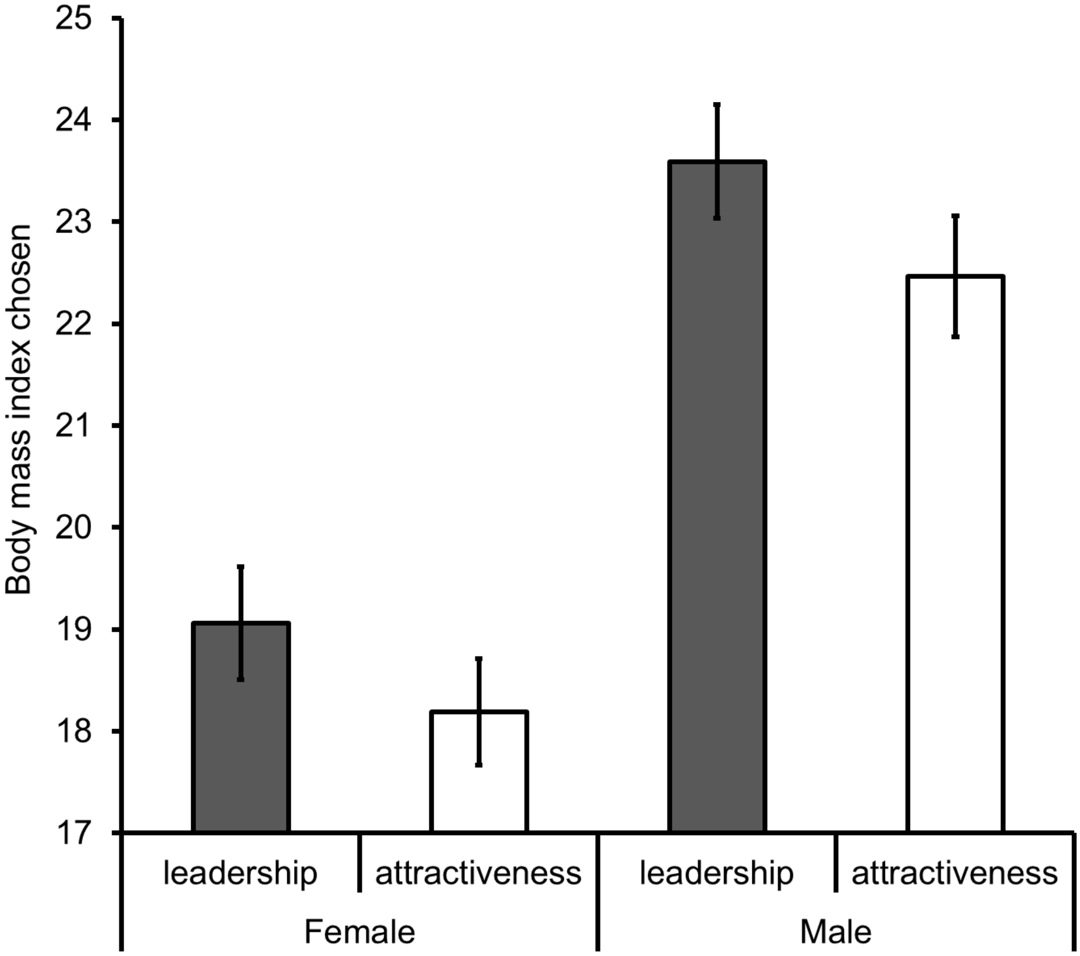

Figure 6.2. Body mass index (BMI) values chosen to maximize perceived leadership ability and attractiveness for male and female faces. Lower BMI values were chosen in the attractiveness task than the leadership task for both female and male faces.

6.3.3 Comparison of attractiveness and leadership tasks

For each composite, the average BMI selected per task was computed across participants. The averaged BMI values for the ten female and ten male composites were then compared for the attractiveness and leadership tasks. A repeated-measures ANOVA found that the BMI values chosen for the leadership task were significantly higher than for the attractiveness task ($F(1,18)=93.01$, $p<0.01$, $\eta_p^2=0.84$). There was a significant effect of face sex, in that participants chose higher BMI values for men's faces than for women's ($F(1,18)=31.64$, $p<0.01$, $\eta_p^2=0.64$). There was no significant interaction between task and face sex ($F(1,18)=1.53$, $p=0.23$, $\eta_p^2=0.08$).

6.4 Discussion

Previous research has demonstrated that attractive faces are more likely to be chosen as leaders in both experimental settings and in real-world elections. The current study used manipulations in facial adiposity to test whether the most attractive face also appeared to be the most leader-like. The results indicate that this is not the case. The most attractive BMI values (18.19 kg/m^2 for women, 22.46 kg/m^2 for men), were significantly lower than those required to maximize leadership perception (19.06 kg/m^2 for women, 23.59 kg/m^2 for men). On average, BMI values chosen in the leadership task were 1.00 kg/m^2 higher than those chosen in the attractiveness task. While 1.00 kg/m^2 may seem like a moderate shift, the large effect size ($\eta_p^2=0.84$) indicates a robust difference in facial adiposity levels chosen between tasks. While facial attractiveness undoubtedly influences perceived leadership quality, the current results suggest that leadership judgments are based on more than attractiveness alone, at least in the context of facial adiposity.

The difference in facial adiposity chosen for maximal attractiveness and leadership appearance may be due to cultural and evolutionary forces. Previous research has indicated that the most attractive BMI for women and men is low, sometimes bordering on unhealthily thin (Coetzee et al., 2012; Coetzee et al., 2011; Tovee & Cornelissen, 2001; Tovee et al., 1998; Tovee et al., 2006). As discussed in Chapter 5, current Western cultural and fashion trends praise thin body types, especially for women, which have led to the perception of thin being beautiful (Heinberg & Thompson, 1995; Thompson & Stice, 2001). Men are susceptible to the influence of media glamorization on perceived body ideals, as well (Lorenzen, Grieve, & Thomas, 2004), and though male models are often muscular, recent trends towards thinner male models may result in a shift towards a thinner male ideal. Indeed, media exposure can lead to increased endorsement of personal thinness in men (Harrison & Cantor, 1997).

In contrast to attractiveness judgments, perceived leadership ability drawn from face images are likely based on cues to physical dominance (Riggio & Riggio, 2010), a topic we will revisit in Chapter 9. Indeed, facial masculinity (which is associated with perceived dominance; (Jones, DeBruine, et al., 2010; Perrett et al., 1998; Watkins, 2011) is a strong predictor of perceived leadership quality, and is especially preferred if a group faces an external threat (Little, Burriss, et al., 2007; Spisak et al., 2012; Spisak et al., 2011). Power and dominance judgments have predicted leadership success in both political elections (Rule et al., 2010) and corporate organizations (Rule & Ambady, 2008, 2009, 2011a, 2011b). Indeed, the facial adiposity perceived as most healthy is higher than that perceived as most attractive (at least for women rating women; Coetzee et al., 2011), and perceived health can also influence leadership judgments (Kramer et al., 2010). The BMI values chosen in the leadership task are closer to those perceived as most healthy than those perceived as most attractive in previous facial adiposity studies (Coetzee et al., 2011). The BMI values chosen to maximize attractiveness may represent too thin a body shape to indicate physical dominance. It is likely that the higher BMI values chosen in the leadership task reflect a preference for leaders to appear physically dominant.

It is important to note that the BMI values chosen by participants in the leadership task are still within a healthy range (18.5-25 kg/m^2; WHO). Just as being too thin may reduce perceived leadership perception, being overweight may also attenuate leadership judgments. Overweight people suffer from personal and professional discrimination (Rand & Macgregor, 1990) and are generally of lower socioeconomic status (Sobal & Stunkard, 1989). Overweight people are also more likely to suffer from poor physical and psychological health (Coetzee et al., 2009; Tinlin et al., 2012). Such factors may impede overweight people from being perceived as capable leaders.

The current study finds that a facial adiposity representing BMIs of 18.19 kg/m^2 (for women) and 22.46 kg/m^2 (for men) were found to be most attractive. While a BMI of 18.19 kg/m^2 is technically classified as underweight by the World Health Organization (<18.5 kg/m^2), this low value is comparable to the maximally-attractive BMI values found in the 3D work in Chapter 5 (19.6 kg/m^2). These values are also close to the maximally-attractive BMI found in studies of women's bodies in western cultures (Tovee & Cornelissen, 2001; Tovee et al., 1998; Tovee et al., 2006).

It is important to note that the current study used young, Caucasian faces as stimuli. Preferences for BMI and facial adiposity vary by culture and resource availability (Coetzee et al., 2012; Swami, Caprario, Tovee, & Furnham, 2006; Tovee et al., 2006). It is therefore possible that BMI values chosen to maximize attractiveness would be different if the stimuli or participants were from a different culture. Likewise, leader preferences vary by social context, both in face (Little, Burriss, et al., 2007; Little et al., 2012; Spisak et al., 2012; Spisak et al., 2011) and voice stimuli (Klofstad, Anderson, & Peters, 2012; Tigue, Borak, O'Connor, Schandl, & Feinberg, 2012). Even preferences for the sex of a leader can be affected by the leadership context (men are preferred as leaders during intergroup conflict, women are preferred as leaders to maintain group relations; van Vugt & Spisak, 2008). It is therefore possible that facial adiposity preferences for leaders' faces could differ based on social context or the culture choosing the leader. Further research on BMI preferences for both attractiveness and leader selection could evaluate differences across cultures and social contexts.

Facial appearance has a great effect on leadership choices (Olivola & Todorov, 2010). The current study finds that facial adiposity influences attractiveness and leadership perception. While facial attractiveness has an impact on perceived leadership ability, the results reported here indicate that the most attractive level of facial adiposity is significantly lower than that chosen to maximize leadership appearance. The BMI difference between optimal attractiveness and leadership perception may stem from cultural and evolutionary forces on perceived attractiveness and leadership selection.

Chapter 7: Looking like a leader - Facial shape predicts perceived height and leadership ability

This chapter is based on research that is under peer-review in an academic journal:

Re D.E., Hunter D.W., Coetzee V., Tiddeman B.P., Xiao D.K., DeBruine L.M., Jones B.C., Perrett, D.I. (in revision). Looking like a leader: Facial shape predicts height and perception of leadership.

Abstract

Judgments of leadership from faces of unfamiliar political candidates predict actual political elections and are correlated with leadership success in the corporate world, yet facial cues to leadership perception remain unclear. Physical height is also associated with political and organizational success. We assessed if cues to height exist in the face and, if so, whether they are associated with perception of leadership ability. We found that facial cues to perceived height had a strong relationship with perceived leadership ability. Furthermore, when manipulated in isolation, participants increased facial cues associated with perceived height to maximize leadership perception. A morphometric analysis of face shape revealed that structural facial masculinity was not responsible for the relationship between perceived height and perceived leadership ability. Given the prominence of facial appearance in making social judgments, facial cues to perceived height may have a significant influence on leadership selection.

7.1 Introduction

Chapter 3 discussed how split-second judgments of competence from facial images predict real-life electoral success. Judgments of competence from briefly presented (i.e., 1/10s) face images have predicted outcomes in United States congressional (Todorov et al., 2005), gubernatorial (Ballew & Todorov, 2007), and presidential elections (Armstrong et al., 2010). Quick leadership judgments from faces have been found to predict voting decisions in the United Kingdom (Banducci et al., 2008; Little, Burriss, et al., 2007), Canada (Rule & Ambady, 2010), Australia (Martin, 1978), Ireland (Buckley et al., 2007), Italy (Castelli et al., 2009), and Japan (Rule et al., 2010).

Perception of leadership ability from facial images also correlates with leader success in the corporate world (see Chapter 3). Profits earned are regarded as a good indication of a business leaders' ability (Kaiser, Hogan, & Craig, 2008). Judgments of power from face images of business CEOs have been found to correlate with company profits in top American businesses (Rule & Ambady, 2008), and similar judgments from faces of Managing Partners correlate with profits earned in law firms (Rule & Ambady, 2011a), a trend that holds for both male and female faces (Rule & Ambady, 2008, 2009). The relationship also exists even if facial images are taken years before a person gains their leadership position, suggesting that face characteristics that influence leadership selection are consistent across time and not developed during leadership roles (Rule & Ambady, 2011b). Taken together, these studies indicate that facial appearance not only influences leadership selection in the political realm, but also actual leadership ability in a corporate context.

Another physical characteristic that affects leadership selection is body height. For example, the taller candidate won 88% of U.S. presidential elections in the 20th century (Sorokowski, 2010), and the difference in candidates' heights predicted the difference in obtained presidential election votes from 1824 to 1992 (McCann, 2001). Outside of politics, height predicts career success and income (Judge & Cable, 2004; Melamed, 1994). Taller men and women run for positions of leadership more frequently (Murray & Schmitz, 2011), and are more likely to be selected to leadership positions within the business world (Judge & Cable, 2004). Taller men and women are also more dominant and assertive (Melamed, 1992) and less anxious (Melamed, 1994). The association between height and perceived leadership ability may reflect the correlation between physical size and rank in leadership hierarchies throughout human history (Murray & Schmitz, 2011).

Given the relationship between both facial appearance and physical height with leadership perception, it is possible that facial cues to height could play a role in leadership selection, especially in circumstances where bodies are occluded from view. Such situations are common; political candidates often stand behind podiums during speeches, sit at tables during debates and are often presented from the neck up on television and in campaign adverts. If cues to height are visible in faces, they may affect perceived leadership ability and bias leadership selection with anatomical information irrelevant to political acumen. The current study will examine whether facial cues to perceived height (cues that impact how tall an individual appears from facial images) influence perceived leadership ability.

To examine how facial characteristics that influence perceived height impact leadership selection, one must investigate possible cues to perceived height in the face.

One possible face cue that could be associated with height is facial elongation (the full length of the face divided by the width). Facial elongation increases from infancy to adulthood, as the lower jaw develops and protrudes from the face (Akgul & Toygar, 2002; Ramanathan & Chellappa, 2006) and faces become less round and more oval (Enlow & Hans, 1996). Facial elongation could therefore be a cue to height. We will examine if facial elongation influences perceived height and test the impact this has on perceived leadership ability.

To investigate how height cues in the face influence leadership selection, one must control for other facial cues already known or suspected to influence perceived leadership ability. For example, Chapter 3 discussed recent research that demonstrates how facial width-to-height ratio predicts leadership success in businesses with low levels of management complexity (Wong et al., 2011) and predicts achievement drive in U.S. presidents (Lewis et al., 2012). It is therefore appropriate to consider the influence of facial width-to-height ratio when examining how facial cues to perceived height influence perceived leadership ability.

Another perceptual trait linked with leadership selection is facial maturity (Rule & Ambady, 2008, 2011a, 2011b). Baby-faced individuals appear less competent (Poutvaara, Jordahl, & Berggren, 2009; Zebrowitz & Montepare, 2005), which could influence leadership perception (Rule & Ambady, 2011a; Zebrowitz & Montepare, 2005). While previous studies have found that baby-faced individuals do not face disadvantages in actual leadership races in The US and Sweden (Poutvaara et al., 2009), facial maturity should be considered when assessing face traits that influence leadership judgments. We will therefore also control for facial maturity when assessing how facial cues to perceived height influence perceived leadership ability.

Finally, leadership selection is also influenced by perceived facial masculinity (see Chapter 3). For example, masculine face structure is preferred in leaders' faces in times of intergroup conflict, while more feminine faces are preferred during periods where within-group conflict is given priority (Little, Burriss, et al., 2007; Spisak et al., 2012; Spisak et al., 2011). It is possible that cues to height are morphologically related to cues associated with masculinity, since men are, on average, taller than women in every culture studied to date (Eveleth, 1975; Gaulin & Boster, 1985). The current study will therefore assess whether facial cues to perceived height are morphologically distinct from those to facial masculinity.

Overview of the Experimental Studies

Both facial appearance and physical height have effects on leadership selection. We will assess whether cues to height are apparent in the face, and test whether these cues influence perception of leadership ability. Study 1 will examine whether physical height can be estimated from unmanipulated photographs of individual's faces, and will test whether perception of height from these images correlates with perceived leadership ability. While previous studies have examined how facial cues influence leadership selection differently based on leadership context (Little, Burriss, et al., 2007; Little et al., 2012; Spisak et al., 2012; Spisak et al., 2011), the current study will investigate the existence of a possible facial cue, perceived height, and examine whether this cue influences leadership judgments in general.

In Study 1, participants will rate unmanipulated facial photographs to assess how perceived height relates to perceived leadership ability. These photographs do not control for extraneous variables, such as skin colour and texture. Study 2 will therefore control for these influences by allowing participants to manipulate face shape alone to alter perceived height in order to maximize leadership perception. Participants will therefore make the face appear to belong to a taller or shorter person while controlling for the influence of skin colour and texture and other face dimensions to maximize leadership perception.

Previous studies have demonstrated that facial masculinity impacts perceived leadership ability (Little, Burriss, et al., 2007; Spisak et al., 2012; Spisak et al., 2011). It is possible that facial cues to height in the face could be morphologically equivalent to facial cues to masculinity. In Study 3, we will use previously established techniques to geometrically calculate structural masculinity "scores" for the faces used in Study 1. We will then assess whether these scores differ across perceived height and leadership ratings collected in from Study 1, and will examine whether structural masculinity scores correlate with body height. Study 3 will therefore differ from the first two studies by focusing on face structure in a geometrically-defined morphological context.

7.2 Study 1: Evaluating height and leadership ability from faces

In Study 1, we assessed if height can be perceived from facial cues alone, and if so, whether facial cues to perceived height also impact perceived leadership ability. First, men's and women's faces were rated for height and leadership ability. We then assessed whether these ratings were related to the actual height of the individuals photographed. We also assessed whether age or sex of the person photographed and perceived facial maturity related to perceived leadership ability. Finally, we computed facial elongation, facial width-to-height ratio, and face area for each face presented to assess whether any of these dimensions predicted perceived height or leadership ability.

7.2.1 Methods

7.2.1.1 Stimuli

We presented participants with Caucasian face images of 47 men (mean age=25.25 years, SD=4.64 years, mean body mass index (BMI)=24.10 kg/m^2, SD=3.52 kg/m^2, 4 with partial beard) and 83 women (mean age=23.04 years, SD=3.81 years, mean BMI=20.05 kg/m^2, SD=4.12 kg/m^2) that were obtained from a commercially available database of face images (available at www.3d.sk). All individuals photographed had their hair pulled back and were photographed under constant lighting and camera set-up. Face images were standardized for inter-pupillary distance and cropped slightly below the chin. Men's heights ranged from 168 cm to 192 cm (mean=179.72 cm, SD=6.43 cm), and women's heights ranged from 156 cm to 184 cm (mean=167.45 cm, SD=6.33 cm).

7.2.1.2 Participants

Twenty-two Caucasian participants (11 men, 11 women, mean age=25.32 years, SD=2.47 years) were recruited from the School of Psychology at the University of St Andrews to rate the faces for height and leadership ability. All participants gave informed consent. Ten participants (5 men, 5 women, mean age=24.07, SD=1.70) independently rated the faces for maturity.

7.2.1.3 Procedure

Participants were presented with the 47 men's faces and 83 women's faces individually in two separate blocks. In one block, participants were asked to "Please rate how tall you think this person is in either feet and inches or cm" and were given eight evenly spaced height divisions from 152 cm to 203 cm (5’0”–6’8”). In another block, participants were asked to rate on a 1 (low) to 7 (high) Likert scale “how good of a leader do you think this person is?” Presentation order of the blocks was counterbalanced. Ten independent participants were asked to rate “How mature-looking is this person” on a scale from 1 (extremely baby-faced) to 7 (extremely mature-faced).

7.2.1.4 Face measurement

Facial elongation was defined as the full length of the face divided by the full width, and was measured for each face (Figure 7.1). Face length and width were calculated using custom face-processing software (Tiddeman et al., 2001). We measured face length by calculating the maximum vertical distance between three x-y coordinates at the top of the forehead and the base of the chin. The width of the face was defined as the maximum horizontal distance between five coordinates outlining the perimeter of the left and right sides of the face (Figure 7.1).

Face width-to-height ratio was measured in the same manner as previous papers (Carre & McCormick, 2008; Stirrat & Perrett, 2010; Weston et al., 2007; Wong et al., 2011). Facial width-to-height ratio was defined as the maximum vertical distance between the crease of the upper eyelid and the top of the upper lip divided by the maximum horizontal width across the sides of the face (Figure 7.1). Facial area was also computed using by calculating the area within the outer perimeters of the face (excluding the ears). Facial width-to-height ratio and face area were measured using the same face-processing software as facial elongation (Tiddeman et al., 2001).

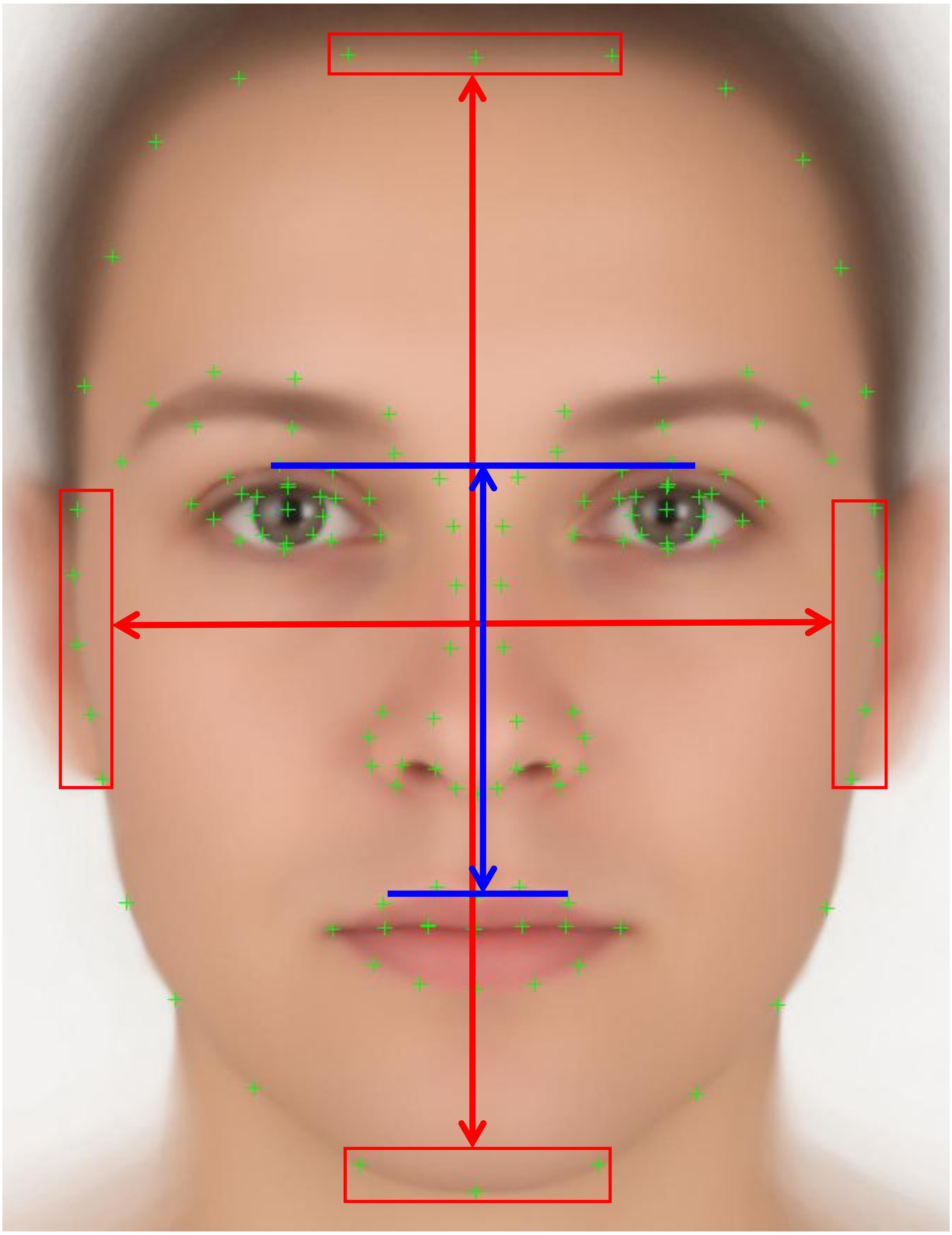

Figure 7.1. An example of face length and width measurements. Facial elongation dimensions are shown in red, facial width-to-height ratio measurements are shown in blue. The 137 delineation points used in the morphometric masculinity analysis are also shown.

7.2.1.5 Analysis

Inter-rater reliability values were calculated for height, leadership and maturity ratings for each sex of face. We then examined how each of the following variables affected perceived leadership ability: perceived height, perceived facial maturity, sex of face, actual height, facial elongation, face width-to-height ratio, age, and face area. Given that perceived height and perceived maturity could be influenced by the other variables, they were entered as endogenous variables in a path analysis with structural equation modelling software (SPSS AMOS)

A full mediational path analysis scale was constructed to assess direct and indirect effects of the variables on leadership judgments (Figure 7.2). Sex of face, actual height, facial elongation, facial width-to-height ratio, age, and face area were entered as exogenous variables (variables inherent to the stimuli and unaffected by other variables in the model) to assess their direct effects on perceived height and perceived leadership ability. All exogenous variables were also tested for their effect on perceived facial maturity with the exception of face area, as there was no theoretical grounding to suspect face area would influence facial maturity and the mathematical restraints of the path diagram demanded the model not be saturated. Perceived height and perceived facial maturity were entered as endogenous variables (perceptual variables that could be affected by the exogenous variables) to test for their relationship with leadership ratings. Disturbance terms were entered for perceived height, perceived facial maturity, and leadership judgments, and the covariance between disturbance terms for perceived height and facial maturity was calculated.

7.2.2 Results and Discussion

Inter-rater reliability was high for both perceived height ratings (n=22, intraclass correlation coefficient [ICC]=0.95) and perceived leadership ratings (n=22, ICC=0.97). Inter-rater reliability was also high for ratings of perceived facial maturity (n=10, ICC=0.88).

The path model (Figure 7.2) fit the data well (χ^2=1.58, χ^2/df= 0.79, Standardized RMR=0.01, RMSEA=0.00, CFI=1.00). Path analysis revealed that perceived height correlated with leadership ratings (β=1.11, p<0.01), while facial maturity had no effect

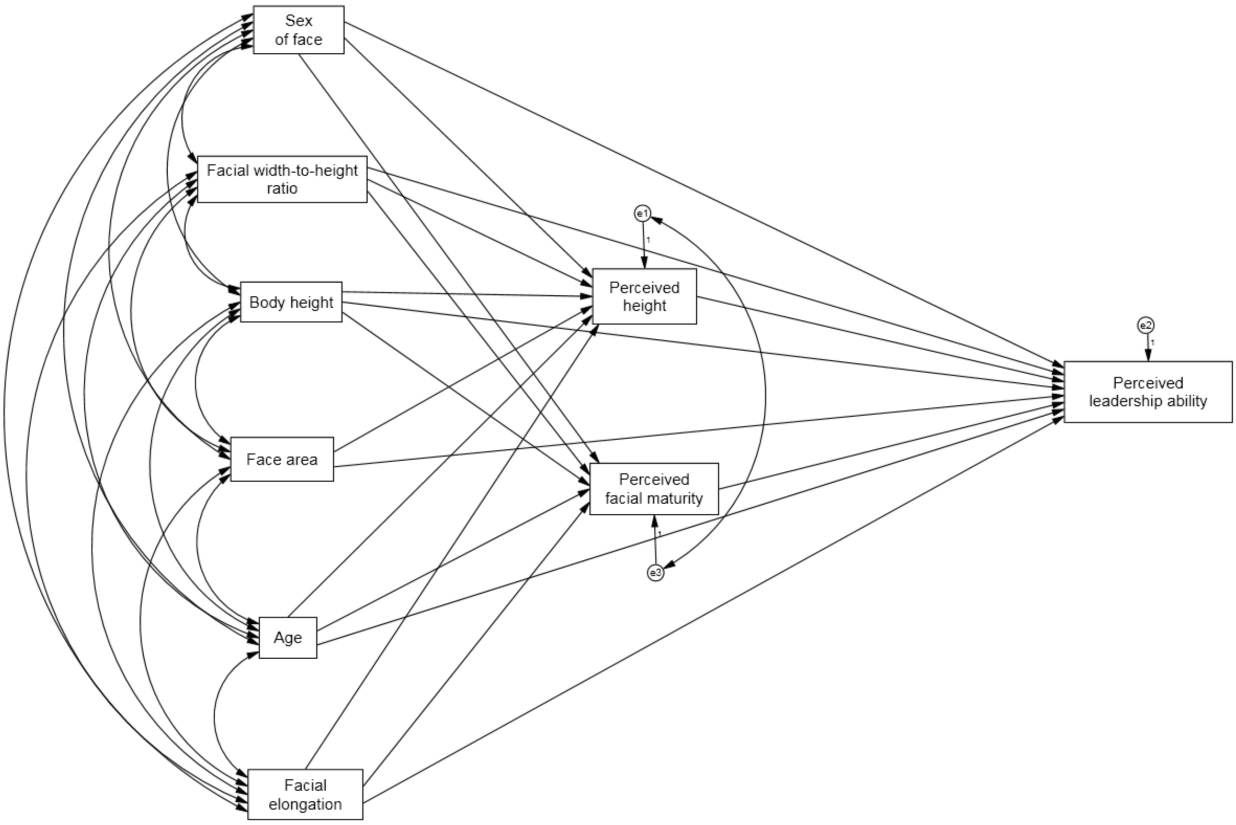

Figure 7.2. Path diagram outlining analyzed relationships between variables. The exogenous variables (sex of face, facial width-to-height ratio, body height, face area, age, and facial elongation) were examined for direct and indirect effects on perceived leadership ability. Endogenous variables (perceived height and perceived facial maturity) were examined for their direct effect on perceived leadership ability.

on leadership ratings in the current sample (β=-0.01, p=0.95). Of the exogenous variables, the sex of face showed a significant direct effect on leadership ratings, with men being perceived as better leaders than women (β=0.79, p<0.01). Age also had a significant direct effect on leadership ratings (β=0.22, p=0.03), with older people being rated as better leaders. There were no other significant direct effects on perceived leadership ability.

Since the exogenous variables could have impacted perceived leadership ability by altering perceived height, we examined the indirect effects of exogenous variables on leadership ratings (Table 1). Impact of the indirect effects was classified by the criterion published by Stroud and Bolger (2002). The sex of face had a large indirect effect on leadership ratings (β=0.80), while facial elongation had a moderate indirect effect on leadership ratings (β=0.18), as did face area (β=0.12) and actual height (β=0.11). These indirect effects are all likely to be mediated via perceived height, as this was the only endogenous variable to impact leadership ratings. Indeed facial elongation (β=0.17, p<0.01), actual height (β=0.10, p=0.03), and face area (β=0.11, p<0.01), all had significant positive direct effects on perceived height, and men were rated as taller than women (β=0.73, p<0.01). Age (β=-0.04) and facial width-to-height ratio (β=-0.06) both had negligible indirect effects on leadership ratings.

Age (β=0.39, p<0.01), actual height (β=0.19, p=0.02), facial width-to-height ratio (β=0.22, p<0.01), all had significant positive direct effects on perceived facial maturity, and men were perceived as more mature-looking than women (β=0.36, p<0.01). No other relationships with perceived height or facial maturity were significant. Disturbance terms between perceived height and facial maturity covaried at a significant level (β=0.09, p<0.01), reflecting a positive correlation between perceived height and maturity. See Table 1 for a full list of regression weights and significance values for all relationships between variables.

Table 1. Standardized regression estimates of the direct and indirect effects of exogenous variables on height, maturity and leadership ratings, and the direct effects of endogenous variables on leadership ratings

	Direct effects			**Indirect effects**
Exogenous variables	Perceived height	Perceived maturity	Perceived leadership ability	Perceived leadership ability
Sex of face	0.72**	0.36**	0.79**	0.80
Facial width-to-height ratio	-0.05	0.22**	0.06	-0.06
Body height	0.10*	0.19*	-0.05	0.11
Facial elongation	0.17**	0.08	0.03	0.18
Age	-0.04	0.39**	0.22*	-0.04
Face area	0.11**	---	-0.10	0.12
Endogenous variables				
Perceived height	---	---	1.11**	---
Perceived maturity	---	---	-0.01	---

p<0.05=, p<0.01=***

Brand & Bradley (2012) suggest that calculating relationships between ratings averaged across participants (such as the perceived height and leadership ratings calculated here) can inflate correlation estimates. To confirm any relationships, they suggest calculating the correlations between two variables of interest for each participant, then computing the average of these correlations. We therefore calculated the individual correlations between height ratings and leadership ratings for each participant, and then averaged those correlations together. Height and leadership ratings were significantly correlated within-participant ($n=130$, average $r=0.20$, $SEM=0.03$, $p=0.01$). The relationship between perceived height and leadership held for both female and male participants (both average $r \geq 0.15$, both $p<0.05$). The relationship between height and leadership ratings was therefore significant at the participant level.

7.3 Study 2: Manipulating perceived height to maximize perceived leadership ability

The faces in Study 1 were natural (i.e., unmanipulated) and not constrained to differences in shape. Skin colour and texture have a profound effect on facial judgments (Jones, Little, Burt, et al., 2004) and affect perceived health (Re et al., 2011; Stephen, Smith, et al., 2009), a trait which has been found to affect voting decisions when viewing avatars of biological motion (Kramer et al., 2010). We therefore needed to assess whether shape cues to perceived height affected perceived leadership ability on their own. In Study 2, we created synthetic faces and transformed them in shape only to manipulate their perceived height. First, we validated our perceived height transforms to ensure that they altered perceived height. We then allowed participants to manually manipulate perceived height in faces in order to maximize perceived leadership ability.

7.3.1 Methods

7.3.1.1 Stimuli

The faces rated for height and leadership ability in Study 1 were delineated with 189 points with custom face-processing software (Tiddeman et al., 2001). Five male and five female face composites were created for transforming. Composites were created by averaging three male or three female faces together (Rowland & Perrett, 1995). Face composites were used to avoid any experimental confounds that may be inherent in an individual face.

Perceived height transforms were produced as in Chapter 4. We created face shape continua of 20 steps for each of the 10 composites by applying ±100% of the shape difference between the perceived height prototypes of the same sex. This created face continua spanning from 100% 'perceived short' shape to 100% 'perceived tall' shape for each composite while maintaining the same identity (Figure 7.3). The transforms manipulated faces in perceived height shape alone, leaving all other face parameters such as colour and texture constant.

7.3.1.2 Participants

To validate the perceived height transform, 16 women and 6 men (mean age: 28.91, SD: 10.96) participated in an online test to rate the height of faces transformed ±50% in perceived height. Twenty separate Caucasian participants (10 men, 10 women, mean age=26.85 years, SD=4.19 years) participated in an interactive leadership task. All participants gave informed consent.

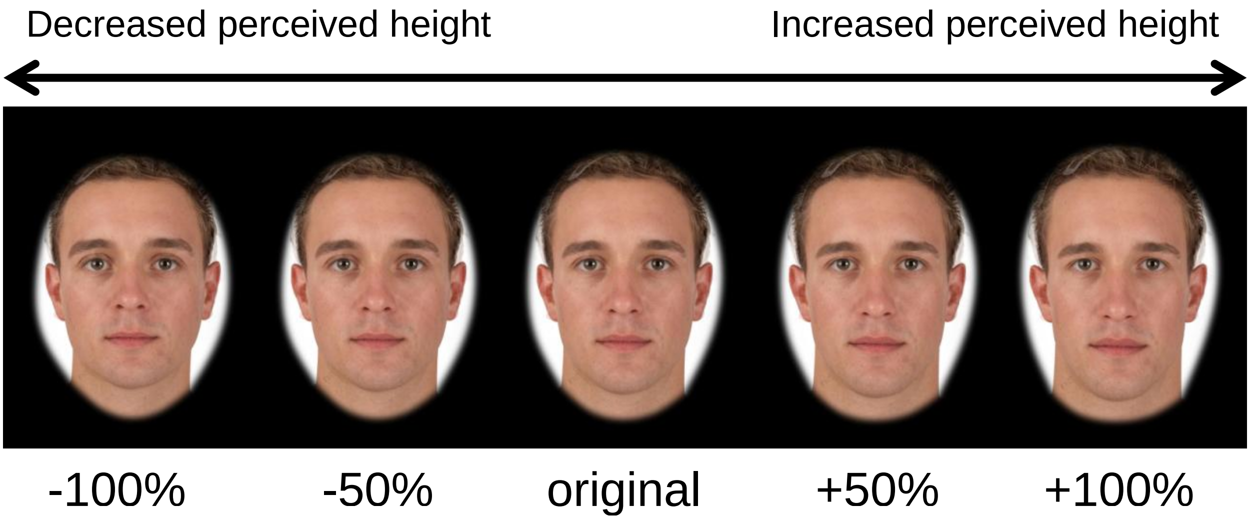

Figure 7.3. An abridged example of the perceived height transform used in Study 2. In the validation task, participants rated the heights of two male and two female composites transformed ±50% in perceived height. In the interactive task, participants were shown a composite and were asked to manipulate its shape to maximize perceived leadership ability, as in Chapter 4. On average, participants increased perceived height by 44.8% to maximize perceived leadership ability.

7.3.1.3 Procedure

A validation task was conducted to ensure our perceived height transforms did in fact alter perceived height. Twenty-two participants were presented with individual images of two male and two female composites transformed ±50% in perceived height (Figure 7.3). Participants were asked to rate how tall each person was on a scale of 1 (extremely short) to 7 (extremely tall).

Twenty separate participants completed an interactive task that required them to manually manipulate perceived height to maximize perceived leadership ability. A custom software program allowed participants to scroll over all 10 face composites (five men, five women) to view the 20 steps in their continua (Figure 7.3), giving the perception that participants were manually transforming face shape. These transforms ensured that participants were only able to alter faces on one dimension (perceived height), while not changing skin colour or texture. We asked participants to transform each composite to make it “most like the person you would perceive as a good leader.” The initial face presented for each trial was randomized for starting degree of transformation. Scroll direction for transformation was also randomized so that scrolling the same way for each composite would not have the same transformation effect (for example, scrolling left may increase perceived height for one trial and decrease perceived height for the next trial). Participants were encouraged to view the whole transform continua before making a selection.

7.3.1.4 Analysis

In the validation task, we averaged height ratings for male and female composites transformed ±50% in perceived height. Paired-samples t-tests were run to determine if the composites decreased and increased in perceived height were rated as different heights.

In the interactive task, each composite had continua of 20 images spanning from 100% “perceived short” shape to 100% “perceived tall” shape. We calculated the average degree of transform used to maximize perceived leadership ability for each composite. One-sample t-tests were conducted to test how each composite was transformed against chance (no transformation).

7.3.2 Results and Discussion

In the validation task, there was an average rating (out of 7) of 3.37 (SD=0.73) for women's composites decreased 50% in perceived height, and 4.84 (SD=1.01) women's composites increased 50% in perceived height. There was an average rating of 4.06 (SD=0.84) for men's composites decreased 50% in perceived height, and 5.06 (SD=0.67) for men's composites increased 50% in perceived height. Paired-samples t-tests revealed that the composites transformed to increase perceived height were rated as taller than those transformed to decrease perceived height for both women's and men's faces (both $t(21) \geq 5.07$, both $p<0.01$, both Cohen's $d \geq 2.21$). Thus, our perceived height transforms did adequately alter perceived height, as in Chapter 4.

In the interactive task, one-sample t-tests against chance (0% transformation) found that all ten composites were increased in perceived height to maximize perceived leadership ability (all $t(19) \geq 3.00$, all $p<0.01$, all Cohen's $d \geq 1.37$). On average, faces were increased in perceived height by 44.8% (SD=12.7%, range=22.6% to 64.8%). A repeated-measures ANOVA showed no effects of the sex of the face ($F(1, 18)=2.90$, $p=0.11$, $\eta_p^2=0.14$) nor the sex of participant ($F(1, 18)=0.30$, $p=0.59$, $\eta_p^2=0.02$) on the degree of transform, and found no significant interaction between these factors ($F(1, 18)=1.31$, $p=0.27$, $\eta_p^2=0.07$).

Study 1 found that faces appearing to belong to taller people were rated as better leaders. In Study 2, participants altered face shape in a way that affected perceived height while retaining the same skin colour and texture information and keeping the identity of the face constant. Participants increased perceived height in all faces to maximize perceived leadership ability. Participants increased face shape associated with taller height by an average of nearly 45% to maximize leadership perception, confirming the relationship between perceived height and leadership ability in faces.

7.4 Study 3: Morphological face cues to height and masculinity

Previous studies have demonstrated that facial cues to masculinity (or sexual dimorphism) affect perceived leadership ability (Little, Burriss, et al., 2007; Spisak et al., 2012; Spisak et al., 2011). We examined whether height and masculinity are morphologically distinct facial cues, and whether morphological masculinity is related to perceived height and leadership judgments. Determining morphological cues to masculinity has been achieved in other studies through principal component analysis (PCA) of face shape and canonical discriminant analysis (CDA) distinguishing the sex of face (Scott et al., 2010). We replicated these methods in order to establish morphological masculinity "scores" for the faces that were rated for height and leadership ability. We then assessed whether masculinity scores were related to height, perceived height, or perceived leadership ability. Study 3 differs from the previous studies in that structural masculinity is computationally calculated, and masculinity scores are then compared across height and leadership ratings collected in Study 1, negating the need for further perceptual ratings given by participants.

7.4.1 Methods

7.4.1.1 Morphological masculinity analysis

A morphometric analysis of facial masculinity was conducted on the faces rated for height and leadership ability. The morphometric analysis followed established methods (Scott et al., 2010). Face delineations were reduced to 137 x-y coordinates (Figure 7.1), eliminating more subjective points from the original delineations and keeping those outlining prominent structural facial features. Each face was then aligned using Procrustes alignment to eliminate variances due to scale, translation and rotation. The face shapes were then parameterized using principal components analysis. Sixteen principal components (PCs) were selected using Kaiser-Guttmann criteria. Each face is thus described as a set of parameters of the 16 retained PCs. Canonical discriminant analysis (CDA) was then performed on the retained PCs to distinguish male and female faces. Morphological masculinity "scores" were created from the CDA output. Masculinity scores were centred on 0, with scores below 0 indicating feminine face structure, and scores above 0 masculine face structure. The further a score deviated from 0, the more morphologically feminine (if below 0) or masculine (if above 0) the face was. See Scott et al. (2010) for more details on producing morphological masculinity scores from face stimuli.

7.4.1.2 Analysis

Masculinity scores were assessed for predictive validity. On the recommendations of Brand & Bradley (2012), we calculated the correlations between structural masculinity scores and the perceived height and leadership ratings for each participant in Study 1. Individual correlations were then averaged to determine the overall correlation between structural masculinity and perceived height or leadership ability. Since structural masculinity scores were defined by differences between women's and men's face shape, we calculated averaged correlations for women's and men's faces separately. We also calculated the correlation between structural masculinity and body height for women's and men's faces.

7.4.2 Results and Discussion

Morphological masculinity scores were based on 16 principal components (PCs) explaining 89.0% of variance in face shape. Masculinity scores correctly predicted sex for 97.4% of faces.

Structural masculinity scores did not correlate with leadership ratings in either women's (n=83, averaged r=0.05, SEM=0.02, p=0.67) or men's (n=47, averaged r=-0.05, SEM=0.02, p=0.74) faces. Structural masculinity scores did not correlate with perceived height ratings in either women's (n=83, averaged r=-0.09, SEM=0.02, p=0.42) or men's (n=47, averaged r=-0.11, SEM=0.03, p=0.46) faces. Structural masculinity was not correlated with body height for women's (n=83, r=0.11, p=0.35) or men's (n=47, r=-0.20, p=0.19) faces.

Masculinity scores correctly predicted sex of face but did not differ with actual height. Masculinity scores showed no relationship with perceived height or leadership ratings. These results indicate that facial cues to perceived height are morphologically distinct from cues to masculinity (Figure 7.4), and do not explain the link between perceived height and leadership perception.

7.5 General Discussion

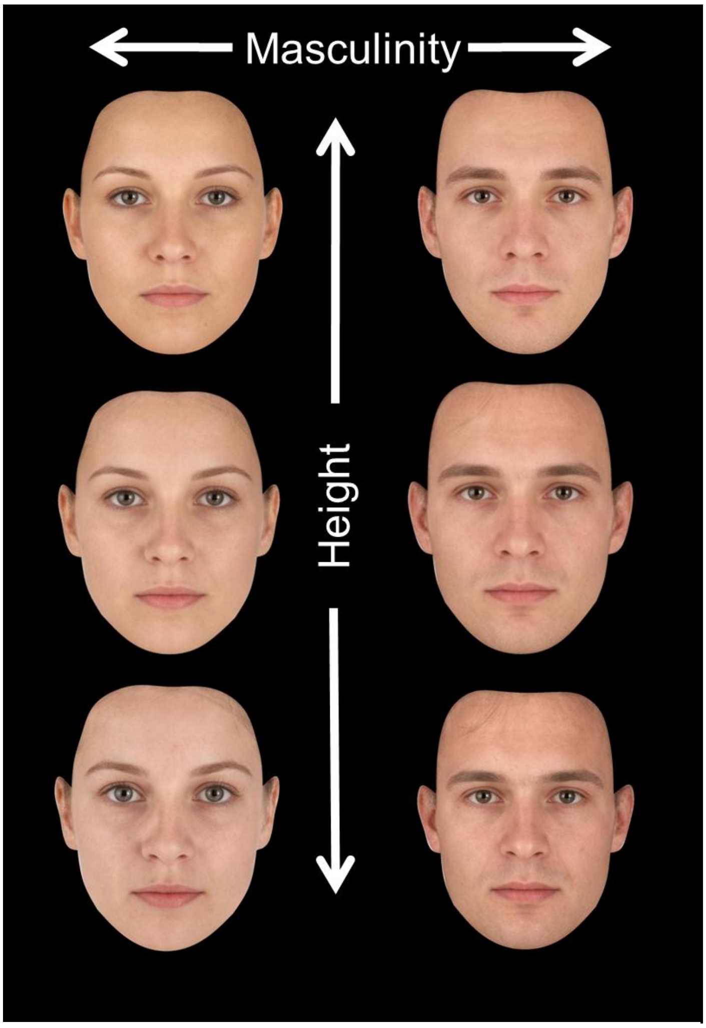

Figure 7.4. An averaged female and male face shape (middle row), and averaged faces of the 10 shortest (bottom row) and tallest (top row) individuals for each sex. Height and masculinity are morphologically distinct parameters in the face.

Study 1 found body height, facial elongation, face area, and sex all impact perceived height, and that perceived height has a strong effect on perceived leadership ability. Study 2 found that, when altered in isolation, structural facial cues that increase perceived height are enhanced to maximize perceived leadership ability. Study 3 revealed that the relationship between perceived height and perceived leadership ability cannot be accounted for via structural masculinity.

Perceived height from faces images had a very strong relationship with perceived leadership ability (β=1.11), yet actual height had no relationship with leadership ratings, even though actual height did have a significant impact on perceived height. Face cues are often overgeneralized for efficient processing at the cost of accurate inferences (Zebrowitz & Montepare, 2008; Zebrowitz & Rhodes, 2004). It is possible that face cues to body height, such as facial elongation, are overgeneralized. Indeed, the relationship between facial elongation and perceived height is stronger than that between body height and perceived height. Such a phenomenon would explain how actual height can predict perceived height, yet lack a significant relationship with perceived leadership. These findings emphasize the importance of facial cues to height in democratic leadership selection. While leader candidates' heights are often unknown or visually obscured in political forums (for example, electoral candidate debates now often take place at tables to offset visible height differences), their faces are often on display in various campaign advertisements and media appearances. Previous research indicates that facial appearance has a great impact on social judgments like attractiveness, maybe more so than body characteristics (Currie & Little, 2009; Mueser et al., 1984; Peters et al., 2007). The current studies suggest facial cues to perceived height have a large effect on leadership ratings. Future work could discern the relative impact of facial cues to perceived height and actual body height in overall leader judgments.

The sex of the photographed individual had a significant direct effect on perceived leadership ability, with men being perceived as better leaders than women. Men's faces are generally perceived to be more dominant than women's faces (Puts, Jones, & DeBruine, 2012), and dominance is correlated with perceived leadership ability in faces (Olivola & Todorov, 2010; Rule & Ambady, 2008). Men are generally preferred as leaders when groups face an external threat such as war, likely because they are viewed as more dominant and aggressive (van Vugt & Spisak, 2008). While women are more likely to adopt a democratic leadership style (Eagly & Johnson, 1990) and are preferred as leaders when the maintenance of intragroup relations is emphasized (van Vugt, Hogan, & Kaiser, 2008), men are quicker to claim leadership roles, even when a woman seems more qualified (Mezulis, Abramson, Hyde, & Hankin, 2004). Women still struggle to attain leadership roles, despite increasing numbers in the workforce (Weyer, 2007), and men hold the majority of leadership positions around the world (Stelter, 2002). The current results suggest the bias towards male leadership extends to facial images.

Age of the individual photographed was found to correlate with leadership ratings. Previous face research has demonstrated that older-looking leaders are preferred when a group faces an external threat (Spisak, 2012). Increasing the apparent age of a known politician makes them appear to be a better leader during times of war (Spisak, 2012). Age correlates with leadership rank in other primate species, at least until bodily senescence makes retaining leadership roles untenable (Hill et al., 2001; Takahashi, 2002). While the photographed individuals in our sample were all grown adults, none of them would have looked "too old" for a leadership role (the age range was 18-40), making age a positive correlate of leadership in our study. Interestingly, while age predicted leadership ratings, perceived facial maturity did not, in spite of the fact that age was a strong positive predictor of facial maturity ratings. Facial maturity does not necessarily equate with perceived age; for example, an individual can have a baby-faced proportions (large forehead, small chin, etc.) but still look old (Olivola & Todorov, 2010). Facial maturity correlates with perceived competence (Olivola & Todorov, 2010; Zebrowitz & Montepare, 2005) and power (Rule & Ambady, 2008, 2011a, 2011b), and increasing babyfacedness in politicians' faces decreases perceived dominance and strength (Keating, Randall, & Kendrick, 1999). While some studies have found a relationship between facial maturity and voting behaviour (Rule et al., 2010), other studies have found that facial maturity does not predict electoral success (Poutvaara et al., 2009). The current study suggests that age, but not necessarily facial maturity, predict perceived leadership ability within a sample of young adults.

Facial width-to-height ratio was not related to perceived leadership ability in the current study. Facial width-to-height ratio is a correlate of actual leadership success for male leaders whose companies demonstrate low levels of management complexity (Wong et al., 2011) and predicts achievement drive in U.S. Presidents (Lewis et al., 2012). Facial width-to-height ratio also positively correlates with measures of aggressiveness and untrustworthy behavior (Carre & McCormick, 2008; Carre et al., 2009; Stirrat & Perrett, 2010). Whereas facial width-to-height ratio correlates with actual measures of leader success and ambitious and aggressive behavior, the current study finds that it does not influence perceived leadership ability. Since facial width-to-height ratio correlates with aggressiveness, it is possible people with high width-to-height ratio would be perceived as good leaders if a situation in which aggressive leadership (i.e. a war context) is called for. Future research could elucidate how facial width-to-height ratio impacts perceived leadership ability under different leadership contexts.

Study 3 demonstrated that structural masculinity was not responsible for the relationship between perceived height and perceived leadership ability. It is important to note that measures of structural masculinity in faces do not necessarily equate to perceived masculinity (how masculine/feminine a face appears). For example, morphometric scores of structural masculinity does not relate to attractiveness ratings (Scott et al., 2010), whereas perceived masculinity has been found to impact attractiveness ratings in many studies (see Perrett, 2010 for review). Future research could elucidate the relationship between perceived height and perceived masculinity, and investigate their relative impacts on perceived leadership ability.

The current studies show a strong positive relationship between perceived height and leadership ability; however it is important to note some limitations. While attempts were made to control for possible face parameters that could influence perceived leadership ability in Study 1, it would be impractical to assess faces for all possible variables. For example, facial attractiveness influences perceived competence, which impacts leadership selection (Olivola & Todorov, 2010). Facial attractiveness has been found to influence electoral success (see Chapter 3). Perceived height has been found to influence facial attractiveness, with both women and men preferring men faces altered to increase perceived height (see Chapter 4). However, the results in Chapter 4 found that participants increased perceived height by 15.12%-21.15% to maximize attractiveness; Study 2 used the same transforms and found that participants altered face shape to increase perceived height by an average of 44.8% to maximize perceived leadership ability. Furthermore, the results of Chapter 4indicate that participants reduced perceived height to maximize attractiveness in women's faces, while perceived height was increased to maximize perceived leadership ability in both women's and men's faces. These studies suggest that while manipulating perceived height affects facial attractiveness, attractiveness cannot explain the relationship between perceived height and perceived leadership ability. See Chapter 10 for further discussion of these points.

Leadership judgments from face images are likely based on cues to dominance and competence (Olivola & Todorov, 2010; Riggio & Riggio, 2010). The relationship between physical height and leadership rank is also likely due to impressions of dominance (Murray & Schmitz, 2011), as taller people self-report more dominant and assertive behavior (Melamed, 1992). It is important to note that the current study lacked ratings of dominance and competence. We speculate that the relationship between perceived height and leadership ability may be mediated by dominance (i.e.-making someone look taller also makes them look more dominant, and thus more leader-like). The current study did not collect ratings of dominance; however this topic will be examined more in Chapter 9.

Previous research has found that social judgments drawn from faces features can impact leadership choice. For example, judgments of trustworthiness and warmth influence perceived leadership ability (Little et al., 2012; Rule & Ambady, 2009; Rule et al., 2010), and emotional expression affects these impressions (Oosterhof & Todorov, 2008). Furthermore, facial features that enhance perceived competence (eyes closer to eyebrows, higher cheekbones, angular jaws) also likely impact leadership judgments (Olivola & Todorov, 2010). The face stimuli used here were all holding neutral (non-emotive) expressions, and Study 2 controlled for emotional variance while altering face shape. While the current study focused primarily on face shape cues to perceived height and leadership ability, the impact of emotional expression and social judgments drawn from the internal facial features cannot be overlooked when examining the effect of faces on leadership selection.

The current study did not specify the context of leadership selection. Previous studies find that facial characteristics are differentially favoured in leaders' faces in varying social contexts. For example, people choose leaders with higher facial masculinity and facial attractiveness in an intergroup conflict context such as war, but choose leaders with more feminine and trustworthy faces in a peace context or when intragroup conflict must be resolved (Little, Burriss, et al., 2007; Little et al., 2012; Spisak et al., 2012; Spisak et al., 2011). Chapter 9 will present research examining the role of social context on preferences for perceived height in leaders' faces.

The current study finds that face shape cues that make an individual appear taller also make them appear to be a better leader. While the relative impact of body height and face cues to perceived height on leadership selection is a subject of further research, faces generally have large effects on social judgments (Peters et al., 2007). Given the relative prominence of faces, and the given that visible body height is often obscured, the current results suggest that facial cues to perceived height could have a great effect on real-world leadership selection.

Chapter 8: Perceived height and body mass index influence perceived leadership ability in three-dimensional faces

This chapter is based on research that has been published in a peer-reviewed journal:

Re, D.E., Dzhelyova, M., Holzleitner, I. J., Tigue, C. C., Feinberg, & Perrett, D.I. (2012). Perceived height and body mass index influence perceived leadership ability in three-dimensional faces. Perception, 41(12), 1477 – 1485.

Abstract

Facial appearance has a well-documented effect on perceived leadership ability. Face judgments of leadership ability predict political election outcomes across the world, and similar judgments of business CEOs predict company profits. Body height is also associated with leadership ability, with taller people attaining positions of leadership more than their shorter counterparts in both politics and in the corporate world. Previous studies have found some face characteristics that are associated with leadership judgments, however there have been no studies with three-dimensional faces. We assessed which facial characteristics drive leadership judgments in three-dimensional faces. We found a perceptual relationship between height and leadership ability. We also found that facial maturity correlated with leadership judgments, and that faces of people with an unhealthily high body-mass index received lower leadership ratings. We conclude that face attributes associated with body size and maturity alter leadership perception, and may influence real-world democratic leadership selection.

8.1 Introduction

As was reviewed in Chapter 7, leadership selection is associated with body height. Height predicts career success and income (Judge & Cable, 2004), and taller men and women are more likely to be selected to leadership positions within the business world (Judge & Cable, 2004). Taller men and women are more dominant and assertive (Melamed, 1992) less anxious (Melamed, 1994), and run for positions of leadership more frequently (Murray & Schmitz, 2011). Chapter 7 described how height influences real-world leadership choice, with taller candidates winning more leadership elections (McCann, 2001) and winning candidates being perceived as taller than losing candidates (Sorokowski, 2010). Height may be associated with leadership through the appearance of physical dominance, which was crucial in attaining leadership roles in our evolutionary past (Murray & Schmitz, 2011).

Taller men are found to have longer faces and narrower jaws (Windhager et al., 2011). Craniofacial research indicates that as the face develops with body growth from infancy to adulthood, the jaw becomes more prominent and the overall face changes from round to oval (Akgul & Toygar, 2002; Enlow & Hans, 1996; Ramanathan & Chellappa, 2006). Chapter 7 demonstrated that facial cues to perceived height are correlated with perception of leadership ability.

Just as cues to body height may affect face judgments of leadership ability, so too do cues to body weight. As explained in Chapter 6, overweight people face many negative stigmas. For example, men and women with high BMI levels face social and professional discrimination (Rand & Macgregor, 1990) and are more likely to be of lower socioeconomic status (Sobal & Stunkard, 1989). High BMI is also correlated with body-image dissatisfaction and lower self-esteem (Stunkard & Wadden, 1992). Chapter 6 showed that higher levels of facial adiposity are needed to maximize perceived leadership than to maximize attractiveness.

One perceptual face trait that has been found to affect leadership judgments is facial maturity. Faces perceived as having a mature look (as opposed to a baby-faced look) appear more dominant (Keating et al., 1999; Keating, Randall, Kendrick, & Gutshall, 2003). Dominance is historically associated with leadership quality (Riggio & Riggio, 2010), and dominant faces are perceived to belong to better leaders (Olivola & Todorov, 2010; Rule & Ambady, 2008, 2009). Chapter 7 reported that actual age correlated with perceived leadership ability, however failed to find any effect of perceived facial maturity on perceived leadership ability in a sample of young adults.

The vast majority of research on face cues to leadership has used two-dimensional (2D) face stimuli. Here, we analyze correlates of perceived leadership ability in three-dimensional (3D) faces. Specifically, we assess how facial cues to height and weight influence leadership judgments. We also extend upon previous studies by determining how facial maturity influences leadership judgments in 3D faces, and control for maturity when assessing how perceived height and weight affects leadership perception. Three-dimensional stimuli provide face information not available in stationary 2D stimuli (Blanz & Vetter, 1999; Tiddeman, Duffy, & Rabey, 2000), and have been successfully used in studies on how face cues to body size affect social attributes such as attractiveness (see Chapter 5). Three-dimensional faces allow viewers to see both the front and sides of a face, creating a more realistic representation of faces as seen in everyday life. Determining cues that influence leadership judgments in 3D faces could have implications for psychologists, political scientists, and anyone with interest in democratic leadership selection.

8.2 Methods

8.2.1 Stimuli

We recruited 90 women (mean age=20.8, age range=18-27) and 59 men (mean age=20.4, age range=18-26) from both the University of St Andrews and McMaster University to have their faces photographed with a 3D face scanner (www.3dmd.com), which provides a surface map of the three-dimensional face structure contours and surface colouration. All photographed participants were Caucasian, had their hair pulled back and were asked to keep a neutral expression. All participants were seated at a constant distance from the camera, and were asked to keep their gaze on a fixed point.

The 90 women had an average height of 166.0 cm (range=149.9-180.3 cm) and an average body-mass index (BMI) of 23.3 (range=18.2-39.1). The 59 men had an average height of 180.1 cm (range=163.0-195.0 cm) and an average BMI of 22.3 (range=17.5-33.4). To assess how healthy, high and low BMIs affected leadership ratings, we divided BMI into three groups: healthy (BMI=18.5-25), overweight (BMI>25), and underweight (BMI<18.5), as defined by the World Health Organization (WHO, 2006). There were 109 people (47 men) in the healthy range, 31 (6 men) in the overweight range, and 9 (6 men) in the underweight range.

8.2.2 Participants and procedure

Twenty-six participants (12 men, 14 women; mean age=23.23, age range=18-37) from the University of St Andrews participated in the experiment. All participants gave informed consent.

Participants were presented with two blocks of faces, one containing all the male faces and one containing all the female faces. In one block, participants were asked to rate each face for "how tall you think this person is" on a scale from 1 (very short) to 7 (very tall). In the other block, participants were asked to rate each face for "how good a leader you think this person would be" on a scale from 1 (very bad) to 7 (very good). Order of the blocks was randomized, and participants were not told what task they would complete in the second block until the first block was completed. Order of the individual faces was randomized within each block, as was the order of the male and female sex groups. Faces rotated 25º on the y axis and 30º on the x axis in a sinusoidal motion at 30º per second. This gave the impression that the head was "bobbing," allowing participants to see both the front and side profiles of each face. Participants were also allowed to scroll to "zoom" in and out on the face in order to view the faces from different apparent depths. All faces were presented on a black background and participants were encouraged to view the full face rotation before answering.

Thirteen separate participants (6 men, 7 women; average age=28.38, range=23-55) rated the faces for facial maturity. Participants were asked to rate "how mature-looking do you think this person is" on a scale from 1 (extremely baby-faced) to 7 (extremely mature-faced). Such ratings have been successfully used to assess facial maturity in previous studies (Berry & Zebrowitz-McArthur, 1988; Friedman & Zebrowitz, 1992).

8.3 Results

Inter-rater reliability was high for judgments of height (Cronbach's α=0.92), leadership (Cronbach's α=0.87) and facial maturity (Cronbach's α=0.81). These ratings were then averaged for each face and used in subsequent analyses. Since BMI was grouped into three main categories (healthy, overweight, and underweight), BMI group was entered as a fixed factor in subsequent analyses.

A MANCOVA was run to determine if actual height (the covariate) predicted ratings of height and leadership ability. Sex of the face was entered as a fixed factor. The MANCOVA revealed actual height predicted height ratings ($F(1, 145)=27.74$, $p<0.01, \eta_p^2=0.16$), but not leadership ratings ($F(1, 145)=0.40$, $p=0.53$, $\eta_p^2<0.01$). There was no effect of sex of face in either rating (both $F(1, 145)\leq0.03$, both $p\geq0.87$), and no interaction between actual height and face sex on either dependent variable (both $F(1, 145)\leq0.03$, both $p\geq0.86$).

A custom univariate ANCOVA was run to determine the effects of perceived height and facial maturity (covariates) and sex of face and BMI group (fixed factors) on leadership ratings. The model also tested to see if sex of face interacted with any other variable. Perceived height ($F(1, 139)=12.32$, $p<0.01$, $\eta_p^2=0.08$; Figure 8.1), facial maturity ($F(1, 139)=5.60$, $p=0.02$, $\eta_p^2=0.04$) and BMI group ($F(2, 139)=5.12$, $p<0.01$, $\eta_p^2=0.07$; Figure 8.2) had significant effects on leadership ratings. Neither sex of face nor any interaction had a significant effect (all $F\leq0.95$, all $p\geq0.39$). Figure 8.3 displays facial averages of the 10 faces rated highest and lowest (per sex) in leadership ability. A separate univariate ANCOVA was run to determine if BMI had an effect on leadership ratings when entered as a covariate (as opposed to being grouped by WHO classifications), with sex of face entered as a fixed factor. We found that BMI had a significant effect on leadership ratings ($F(1, 145)=15.26$, $p<0.01$, $\eta_p^2=0.10$). There was no significant interaction between BMI and sex of face ($F(1, 145)=0.04$, $p=0.85$, $p<0.01$).

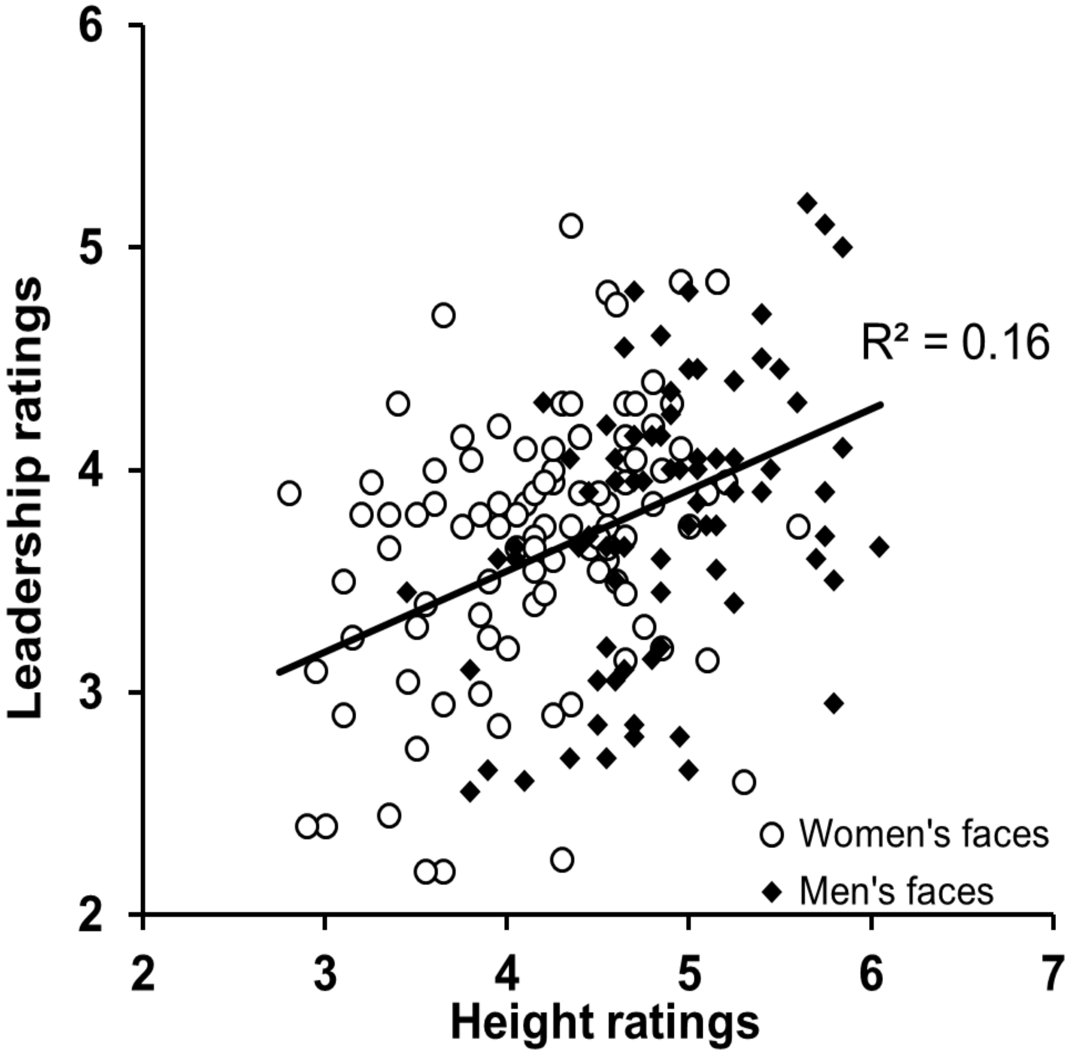

Figure 8.1. Leadership ratings as a function of perceived height for women's (circles) and men's (diamonds) faces, including regression line. Both ratings were on a 1-7 Likert scale. Perceived height predicted leadership ratings for both women's and men's faces.

Post hoc tests using Bonferroni correction revealed that people in the healthy BMI range had higher leadership ratings than those defined as overweight (p=0.01), while leadership ratings for underweight people were not significantly different from healthy (p=0.74) or overweight people (p=1.0) (Figure 8.2).

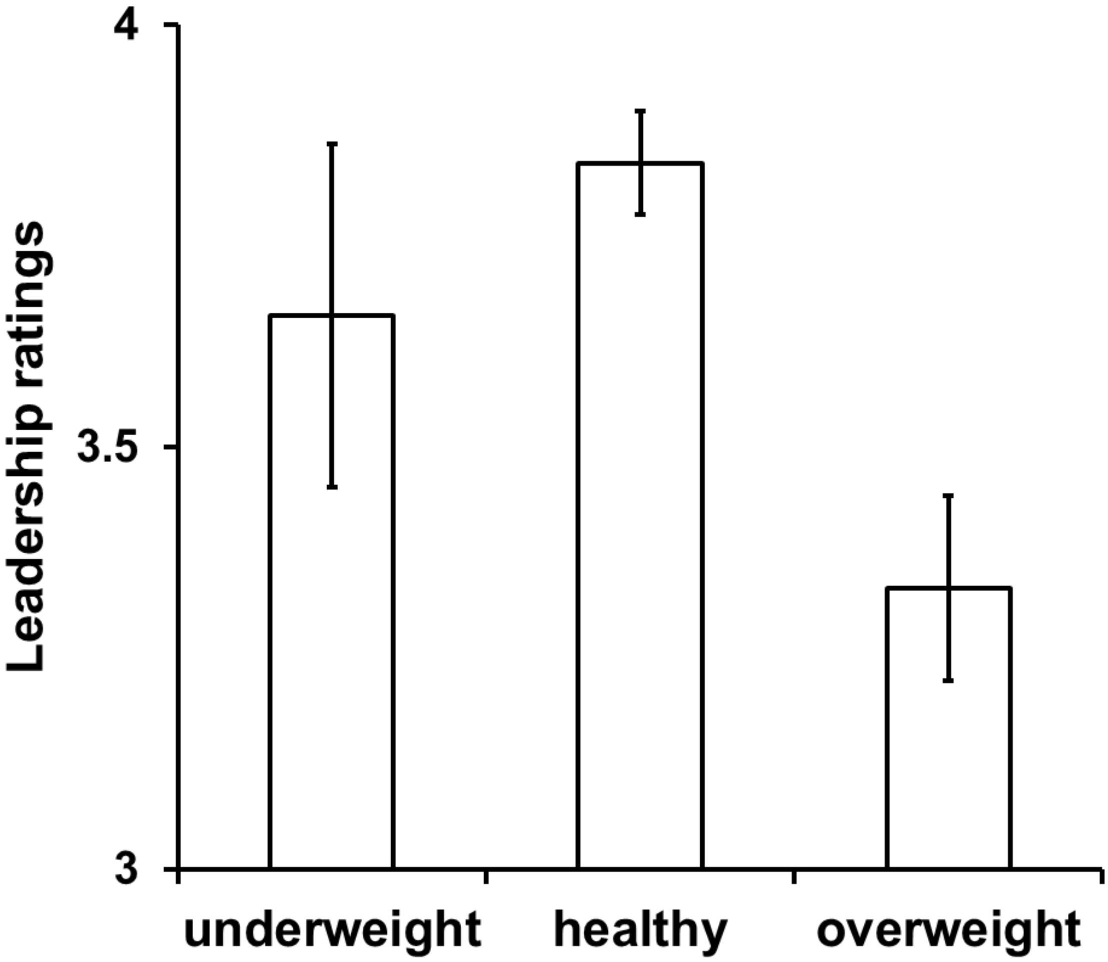

Figure 8.2. Leadership ratings as a function of body mass index (BMI) for underweight (BMI<18.5), healthy (BMI=18.5-25), and overweight (BMI>25) groups. Leadership ratings were significantly lower for the overweight group, while ratings for the underweight and healthy group were not significantly different.

On the recommendations of Brand & Bradley (2012), we calculated the individual correlations between height ratings and leadership ratings for each participant, and then averaged those correlations together. We found that height and leadership ratings for each face were significantly correlated within-participant ($n=149$, average $r=0.16$, $SEM=0.03$, $p<0.05$). Similarly, we also calculated the average of correlations between individual leadership ratings and BMI, actual height, and averaged facial maturity ratings for each face. We found BMI ($n=149$, average $r=-0.17$, $SEM=0.02$, $p=0.04$) and averaged facial maturity ratings ($n=149$, average $r=0.16$, $SEM=0.02$, $p=0.048$) significantly correlated with leadership ratings, while actual height ($n=149$, average $r=0.03$, $SEM=0.02$, $p=0.67$) did not. Thus, perceived height, BMI, and facial maturity all significantly correlated with leadership ratings at the level of individual raters, and support the calculations made using averaged ratings.

8.4 Discussion

Faces perceived to belong to taller people were perceived to be better leaders in both men's and women's faces. Height has a well-documented effect on leadership choices in both politics (Sorokowski, 2010) and the business world (Judge & Cable, 2004). The results of the current experiment suggest that face cues to perceived height may mediate part of the perceptual relationship between height and leadership ability. While perceived height showed a strong relationship with leadership judgments, the actual height of the people photographed did not affect perceived leadership ability, similar to results found in Chapter 7. These results are in

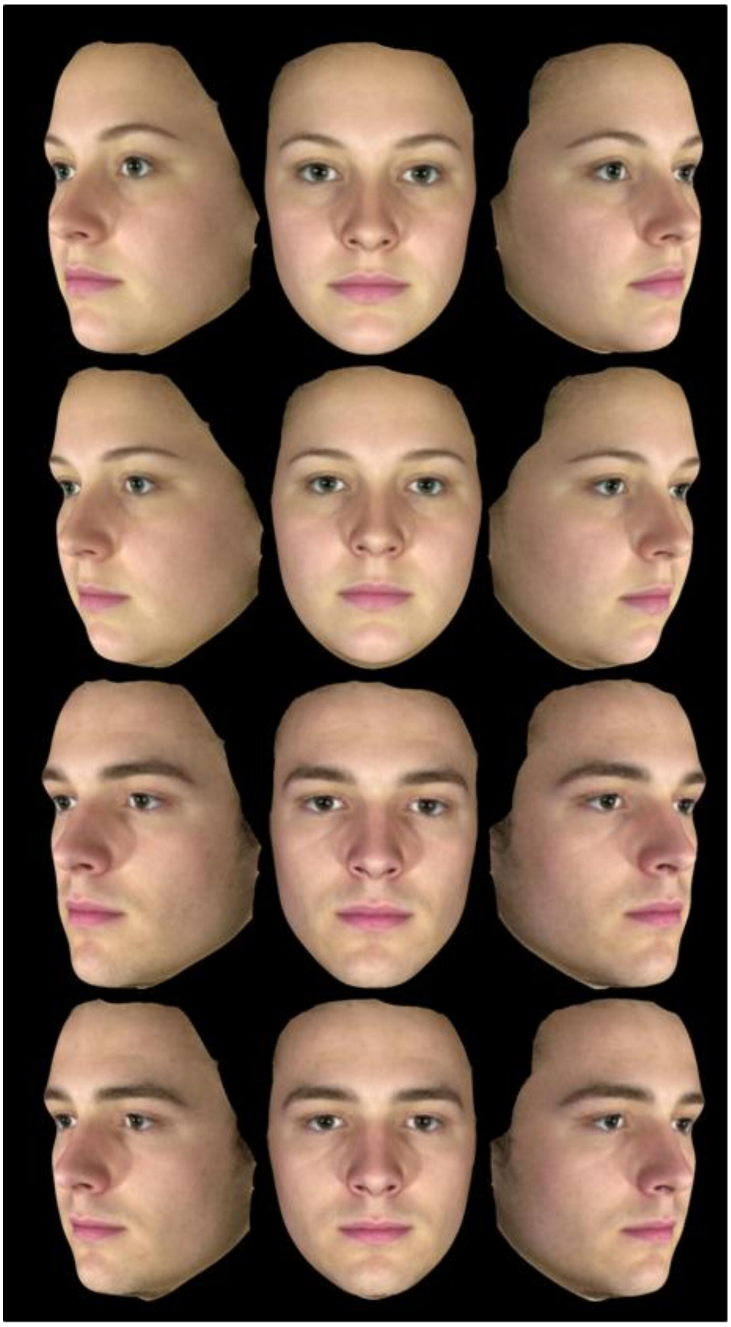

Figure 8.3. Face averages of the ten people with the highest (rows 1 and 3) and lowest (rows 2 and 4) leadership ratings within sex. Perceived height and maturity predicted leadership ratings, while faces of overweight people had lower leadership ratings.

contrast to the association typically found between body height and leadership perception (Judge & Cable, 2004; Sorokowski, 2010).

People in the overweight BMI group were less likely to be perceived as good leaders than people in the healthy or underweight group (though the small sample size in the underweight group should be noted, see Chapter 6 for an experiment on facial adiposity/leadership selection using a wide range of adiposity stimuli). The negative relationship between perceived leadership ability and BMI aligns with other research on perceived personality attributes and weight (Melamed, 1994; Rand & Macgregor, 1990; Sobal & Stunkard, 1989; Stunkard & Wadden, 1992). People with high facial adiposity also suffer from poorer mental health (Tinlin et al., 2012), which may adversely affect leadership ability. The perceptual association between high facial adiposity and negative personality traits and poor mental condition may deter people from viewing obese individuals as good leaders.

Facial maturity also positively correlated with perceived leadership ability in 3D faces, an effect not found in the 2D sample in Chapter 7 (even though actual age had an effect on perceived leadership ability in that sample). Facial maturity affected leadership ratings independent of perceived height and BMI, even though the age range in stimuli used here was relatively small (ages18-26). It is unclear why facial maturity would impact leadership perception in 3D faces, but not the 2D sample in Chapter 7. It is possible that the extra visual cues found in 3D faces (jaw and brow protuberance, etc.) contributed to the perception of maturity and enhanced the association between maturity and perceived leadership ability.

Face judgments of leadership ability influence actual leadership choices in both politics (see Olivola & Todorov, 2010) and business (Rule & Ambady, 2008, 2009;

Rule, Ishii, & Ambady, 2011), and body characteristics such as height and weight affect perceived leadership ability (Murray & Schmitz, 2011). The current study finds that facial traits associated with height and BMI affect leadership judgments in realistic 3D faces, just they did with 2D faces. These results have implications for real-world leadership selection. Visual cues to the body characteristics of potential leaders are not often displayed; for example political candidates are often seated at tables or stand behind podium during debates, and are viewed from the waist or neck up on television and in media campaign advertisements. The same visual media focuses extensively on leader candidates' faces, however, and the current results indicate such face presentation can sway perception of leadership adequacy. Face images of leader candidates are displayed with high frequency during times of leadership elections, and the influence of facial cues to perceived height, BMI and maturity are likely to impact on real-world leadership choices.

Chapter 9: Facial cues to perceived height influence leadership choices in simulated war and peace contexts

This chapter is based on research that has been published in a peer-reviewed journal:

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

Abstract

Body size and other signs of physical prowess are associated with leadership hierarchies in many social species. Here we (1) assess whether facial cues associated with perceived height and masculinity have different effects on leadership judgments in simulated wartime and peacetime contexts and (2) test how facial cues associated with perceived height and masculinity influence dominance perceptions. Results indicate that cues associated with perceived height and masculinity in potential leaders' faces are valued more in a wartime than peacetime context. Furthermore, increasing cues of perceived height and masculinity in faces increased perceived dominance. Together, these findings suggest that facial cues of physical stature contribute to establishing leadership hierarchies in humans.

9.1 Introduction

Chapter 3 discussed how facial appearance can influence real world election choice. Chapters 6, 7 and 8 examined how facial cues to body size alter perceived leadership ability. Those chapters speculated that facial cues to body size alter perceived facial dominance (summarised in Chapter 1), which impacts leadership choice (see Chapter 3). The ability to quickly evaluate potential leadership ability may draw upon snap judgments of physical dominance (Murray & Schmitz, 2011; Riggio & Riggio, 2010). In voices, deep pitch is perceived as masculine and physically dominant (Feinberg, Jones, Little, Burt, & Perrett, 2005; Puts, Hodges, Cardenas, & Gaulin, 2007), and people prefer political candidates with lower voice pitch (Klofstad et al., 2012; Tigue et al., 2012). Physical size and dominance predicts leadership hierarchies in several primate species (de Waal, 2005, 2007; Mason & Mendoza, 1993; Sapolsky, 2005) and the associations among physical stature, dominance and leadership ability in humans may reflect the use of size and strength in determining social status throughout history (Murray & Schmitz, 2011; Puts, 2010; Riggio & Riggio, 2010). Indeed, physical body strength can be assessed from faces (Sell et al., 2009) and is correlated with facial dominance and masculinity (Fink, Neave, & Seydel, 2007; Windhager et al., 2011). In some studies facial masculinity is also correlated with levels of circulating and reactive testosterone (Penton-Voak & Chen, 2004; Pound et al., 2009), a hormone found to be associated with dominant behavior (Mazur & Booth, 1998).

People with masculine, dominant-looking faces are more likely to be perceived as good leaders. However, this preference is influenced by the context for which a leader is required (see Chapter 3). Preferences for facial masculinity (and by association, perceived dominance) in leaders are strengthened when a group is subject to an external threat. Little, Burriss, Jones and Roberts (2007) compared masculinized and feminized faces to assess leadership choices in the context of war and peace. In the war context, masculinized faces were more likely to be chosen, while the feminized faces were more likely to be chosen in the peace context (Little, Burriss, et al., 2007), preferences which were later found to extend across cultures (Spisak et al., 2012). In a similar vein, Spisak et al. (2011) found masculinized faces were chosen as leaders in social contexts where the simulated in-group (the participants choosing their preferred leader) competed against an out-group, while feminized faces were preferred when within-group cooperation was given higher priority. Further studies report different facial attributions, such as attractiveness, are more preferred in leaders' faces in war contexts, while other attributions, such as trustworthiness, are preferred in peace contexts (Little et al., 2012), and that lower-pitched (and hence more dominant-sounding) voices are preferred in leaders in a war context (Tigue et al., 2012). In general, men are perceived as more dominant and competitive than women, and are preferred as leaders more during times of intergroup conflict (van Vugt & Spisak, 2008). Conversely, women are perceived as more peaceful and better able to resolve conflicts than men, and are preferred as leaders more during times of conflict within a group (van Vugt & Spisak, 2008). Together, these studies indicate the need to assess preferences for leaders in the context of intergroup conflict or peace.

Another physical dimension that influences leadership selection is height. Height correlates ranks in real-world leadership hierarchies. Height may be associated with leadership due to the advantages of physical dominance in climbing dominance hierarchies in our evolutionary past (Murray & Schmitz, 2011).

Research in craniofacial anatomy reveals that faces develop along with regular body growth (see Chapter 1). Faces become longer from infancy to adulthood, with overall face shape changing from round to oval and the jaw becoming more pronounced (Akgul & Toygar, 2002; Enlow & Hans, 1996; Ramanathan & Chellappa, 2006). Chapters 7 and 8 demonstrated that facial cues to perceived height have an effect on perceived leadership ability, with faces thought to belong to taller people being rated as better leaders.

While studies have already demonstrated that preferences for facial masculinity in leaders varies by leadership context (e.g., wartime versus peacetime), it is unclear whether preferences for perceived height in leaders also varies by context. The results presented in Chapter 7 found that face cues to height were structurally distinct from cues to masculinity, therefore it is possible that preferences for perceived height in leaders may not follow those for facial masculinity. If, however, perceived height is associated with physical dominance, it may be that faces appearing to belong to taller people would be preferred for leaders in intergroup conflicts, while height preferences may be less pronounced in group situations lacking an external threat.

The current experiment examines whether face cues to perceived height affect leadership choices differently when intergroup conflict is simulated. We follow the methods of Little et al. (Little, Burriss, et al., 2007; 2012) to determine if preferences for leaders' perceived height differ between war and peace contexts (Experiment 1). Furthermore, we aim to replicate the findings of Little et al. (2007) by testing whether preferences for masculinized faces are stronger in a war context. Finally, we assess whether facial cues to perceived height and masculinity affect perceived dominance (Experiment 2).

9.2 Experiment 1. Manipulating perceived height and masculinity to maximize leadership

9.2.1 Methods

9.2.1.1 Face stimuli

We presented participants with Caucasian face images of 47 men (mean age=25.3 years, SD=4.64 years) and 83 women (mean age=23.0 years, SD=3.81 years) that were obtained from a commercially available database of face images (available at www.3d.sk). Men's heights ranged from 168 cm to 192 cm (mean=179.72 cm, SD=6.43 cm), and women's heights ranged from 156 cm to 184 cm (mean=167.45 cm, SD=6.33 cm). All photographed individuals had their hair pulled back and were photographed under constant lighting and camera set-up. Face images were standardized on pupil position. Twenty-two participants (11 men, 11 women) were asked to ''please rate how tall you think this person is in either feet and inches or cm'' and were given eight evenly spaced height divisions from 152 cm to 203 cm (5'0"– 6'8"). See Chapter 4 for more details.

We used specialist computer graphic software (Tiddeman et al., 2001) to average the 10 faces (for each sex) perceived as belonging to the shortest individuals (to create 'short' prototypes) and the 10 faces perceived as belonging to the tallest individuals (to create 'tall' prototypes), just as in Chapters 4 and 7.

We created five male and five female face composites to use in experimental testing by averaging the faces of three individual men or women (Rowland & Perrett, 1995). Some of the individual photographs used in the prototypes were also used in the composites. The male composites had averaged heights of 170.67 cm (SD=2.52 cm, average age=25.33 years, SD age=5.13 years), 176.00 cm (SD=0.00 cm, average age=27.33 years, SD age=2.52 years), 182.00 cm (SD=0.00 cm, average age=23.00 years, SD age=3.00 years), 188.67 cm (SD=1.52 cm, average age=25.00 years, SD age=2.65 years) and 194.33 cm (SD=4.93 cm, average age=24.00 years, SD age=6.93 years). The female composites had average heights of 156.00 cm (SD=1.00 cm, average age=22.00 years, SD age=6.93 years), 167.00 cm (SD=0.00 cm, average age=24.67 years, SD age=3.06 years), 169.00 cm (SD=7.54 cm, average age=23.00 years, SD age=2.65 years), 170.67 cm (SD=2.08 cm, average age=22.67 years, SD age=3.51 years), and 181.33 cm (SD=3.06 cm, average age=18.16 years, SD age=0.58 years).

Next, we created perceived height continua to use for experimental testing (as in Chapters 4 and 7). Male stimuli were manufactured by adding or subtracting percentages of the shape difference between the tall and short male prototypes to five male composite faces (Rowland & Perrett, 1995). Female stimuli were manufactured in the same way by adding or subtracting percentages of the shape difference between the tall and short female prototypes to five female composite faces (Rowland & Perrett, 1995). This process created ten face continua (five male, five female) which spanned from 100% ‘short’ face shape to 100% ‘tall’ face shape (in 20 images for each continua).

A manipulation check (i.e., pilot study) was conducted to establish whether our perceived height transforms altered perceptions of individuals’ height. Twenty-two participants (16 women, 6 men) were presented with individual images of two male and two female composites transformed ±50% in perceived height. Participants were asked to rate how tall each person was on a scale of 1 (extremely short) to 7 (extremely tall). Paired-samples t-tests revealed that the composites increased in perceived height were rated as taller than those decreased in perceived height for both women's and men's faces (both $t(21) \geq 5.07$, both $p < 0.01$). These results confirm that our methods for manipulating face shape cues to perceived height reliably alter height perceptions. None of the participants in the pilot study took part in the main studies.

Masculinity transforms for each of the five male and five female composites were also created using established methods for manipulating sexually dimorphic shape cues in faces (DeBruine et al., 2006; Perrett et al., 1998). First, male and female prototypes were created by separately averaging all 47 individual male faces and all 83 individual female faces. Masculinity transforms were then created by adding or subtracting percentages of the shape difference between the male and female prototypes to each of our five male and five female composites (creating 10 continua of 20 images). Previous research has demonstrated the efficacy of masculinity transforms in altering perceived facial masculinity (DeBruine, Jones, Crawford, et al., 2010; DeBruine et al., 2006; Welling et al., 2008).

Faces for both the perceived height and masculinity transforms were masked around the head so that clothing cues were not visible (Figure 9.1). Inter-pupillary distance was standardized to avoid changes in overal head size across transforms.

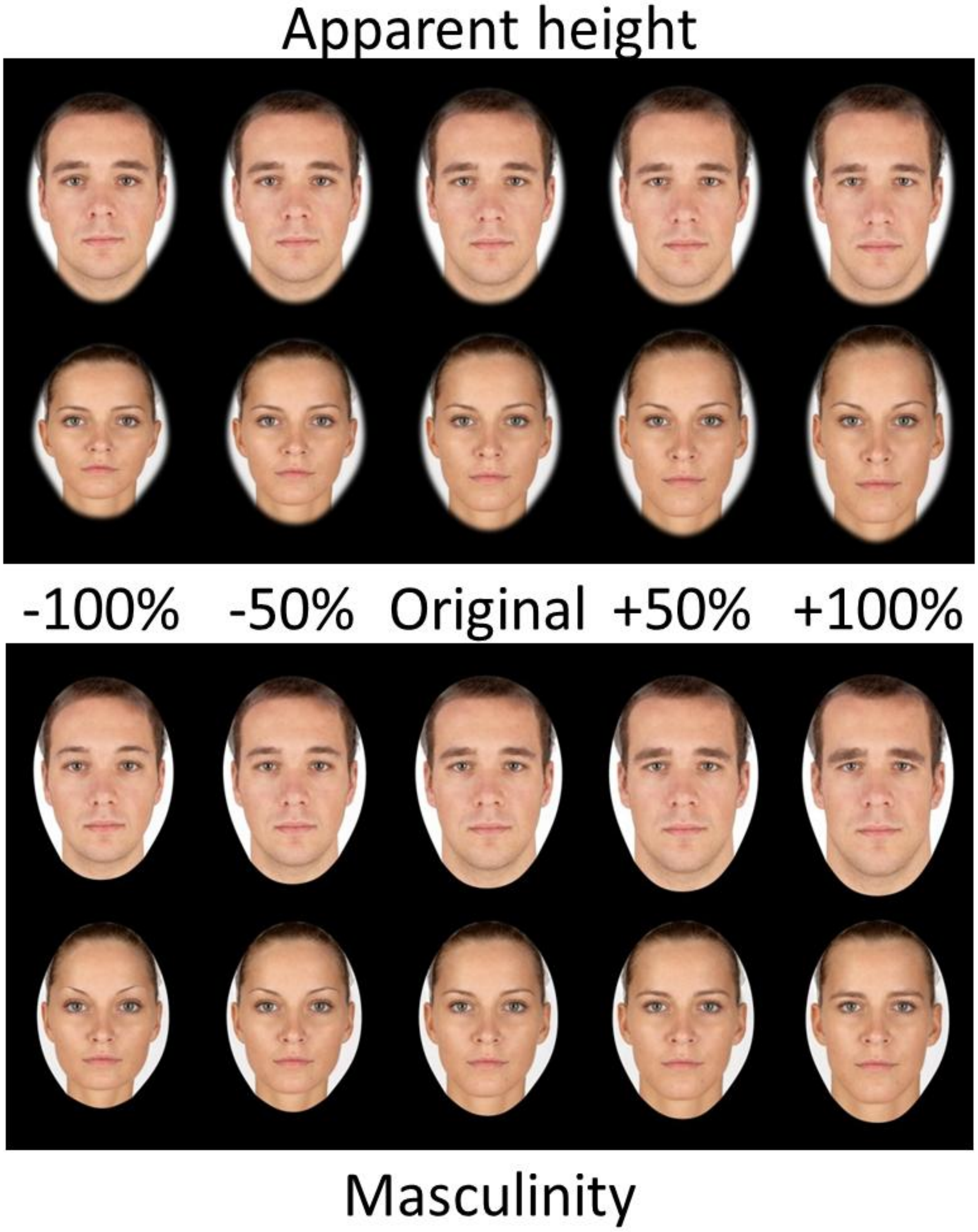

Figure 9.1. Examples of perceived height (top row) and masculinity (bottom row) transforms for male and female faces. In Experiment 1, participants were allowed to manually transform faces ± 100% or any point in-between to maximize perceived leadership. In Experiment 2, the ±50% transformed images of two male and two female faces were rated for dominance.

9.2.1.2 Participants and procedure

Thirty-five women and 22 men (mean age=22.77 years, SD=7.34 years) completed the experiment online. The study was approved by the institutional ethics committee. All participants gave informed consent. The twenty face continua (five male perceived height continua, five female perceived height continua, five male masculinity continua, and five female masculinity continua) were presented to the participants in two blocks. In one block, participants were instructed to scroll over the face to manually transform it and asked to "Please change the face to most resemble someone you would like to lead your country in a time of PEACE." In the other block, participants were asked "Please change the face to most resemble someone you would like to lead your country in a time of WAR." Order of the blocks was randomized.

Analysis

For each participant, we analyzed all trials and calculated the average transform required to maximize leadership for judgment type (war versus peace context), sex of face (male versus female), and face manipulation (masculinity versus perceived height). Since the perceived heights of the prototypes used in the perceived height transforms were known, we were able to calculate the average change in perceived height for each perceived height transform.

9.2.2 Results

In the peace context, masculinity was decreased from the original composites by 16.6% in female faces and 7.85% in male faces. Perceived height was decreased by 0.38% (0.03 cm) in female faces, but increased by 5.93% (0.48 cm) in male faces. In the war context, masculinity was increased from the original composites by 15.9% in female faces and 35.1% in male faces. Perceived height was increased by 34.9% (3.26 cm) in female faces and 45.8% (3.70 cm) in male faces. One-sample t-tests against chance (0% transformation) found that both masculinity and perceived height were significantly increased in the war context for both male and female faces (all $t(56) \geq 2.44$, all $p \leq 0.02$, all Cohen's $d \geq 0.65$). Female faces were significantly decreased in masculinity in the peace context ($t(56)=-3.70$, $p<0.01$, Cohen's $d=0.99$). There were no other significant transformations in masculinity or perceived height in the peace context (all $t(56) \leq 1.61$, all $p \geq 0.11$, all Cohen's $d \leq 0.43$).

A 2x2x2 mixed-design ANOVA was conducted with transform type (masculinity vs. height), context (war vs. peace), and face sex (male vs. female) as within-subjects variables and the degree of increase in masculinity or height required to maximize perceived leadership ability for each face as the dependent variable. Participant sex (male vs. female) was entered as a between-subjects variable. The ANOVA found a main effect of transform type, with perceived height being increased more than masculinity to maximize perceived leadership ability ($F(1,55)=45.12$, $p<0.01$, partial eta-squared (η_p^2)=0.45; Figure 9.2). There was a main effect of context, with faces being increased in masculinity or height to a greater degree in the war condition than the peace condition ($F(1,55)=57.74$, $p<0.01$, $\eta_p^2=0.51$). There was also a main effect of face sex, with male faces being increased in masculinity or height to a greater degree than female faces ($F(1,55)=10.37$, $p<0.01$, $\eta_p^2=0.16$). There were no interactions among transform, context, and face sex, or any combination of these three factors. There was also no effect of participant sex on the degree of transform ($F(1,55)=0.20$, $p=0.66$, $\eta_p^2<0.01$), and no interactions between participant sex and any transform type, context, or face sex (all $F(1,55) \leq 0.60$, all $p \geq 0.44$, all $\eta_p^2<0.01$).

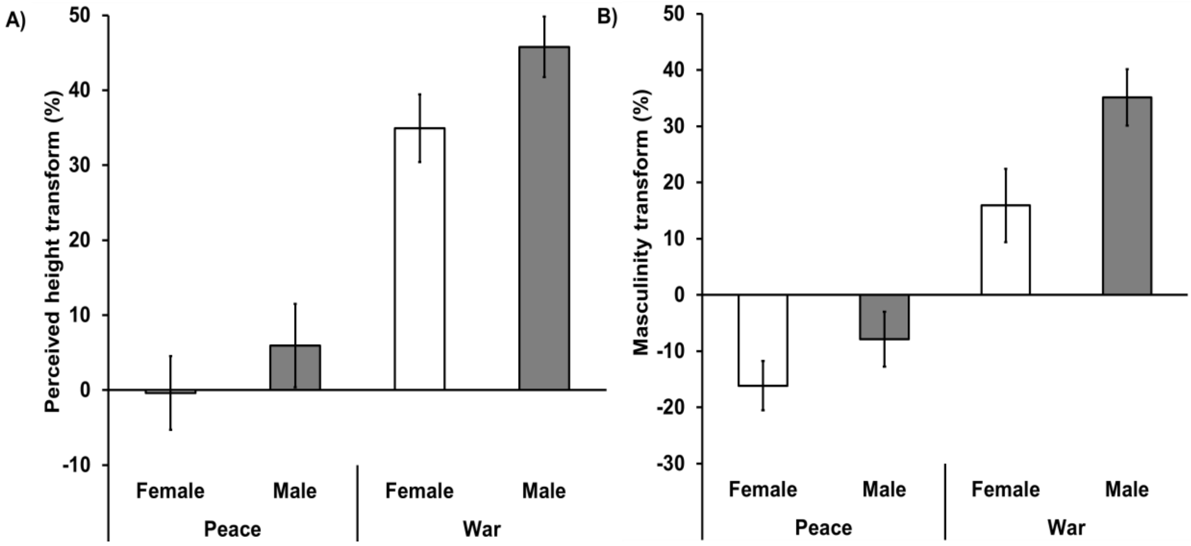

Figure 9.2. Mean transformation and standard error for (A) perceived height transforms and (B) masculinity transforms for male faces (grey bars) and female faces (white bars) in contexts of peace and war. Perceived height and masculinity were increased more in the war context to maximize perceived leadership ability in both male and female faces.

Experiment 1 found that faces were increased in both perceived height and masculinity more in a war context than a peace context. These results replicate those of previous experiments that investigated the context-specific effects of facial masculinity on hypothetical voting decisions (Little, Burriss, et al., 2007; Spisak et al., 2011) and show that similar results are obtained when cues of perceived height are manipulated in face images.

9.3 Experiment 2 – Effects of perceived height and masculinity on perceived dominance

Both perceived height and masculinity were increased to maximize perceived leadership ability in the war context, while they were not significantly increased in the peace context. Masculinity was also significantly decreased in female faces in a peace context. These results suggest that both perceived height and masculinity influence perceived dominance, as leaders with dominant traits are preferred in times of intergroup conflict (Tigue et al., 2012; van Vugt & Spisak, 2008). Experiment 2 examines whether perceived height and masculinity both affect perceived dominance. Previous research has found facial masculinity affects perceived dominance (DeBruine et al., 2006; Puts, 2010). No research has been conducted on the possible effect of cues of perceived height on the perceived dominance of faces.

9.3.1 Methods

9.3.1.1 Participants and Procedure

Fourteen women and 9 men (mean age=27.04, SD=10.64) completed the experiment online. All participants were asked to indicate their sex and age and gave informed consent.

Two male and two female face composites transformed ±50% in perceived height and ±50% in masculinity (Figure 9.1) were rated for perceived dominance. Participants were presented two blocks of faces, one for male faces and one for female faces. Each block presented eight faces, comprised of 2 composites transformed ±50% in masculinity and perceived height (2 composites x 2 transform types x 2 degrees of transform). Both the block order and face order within a block were randomized. Participants were asked to please rate, on a 1 (extremely submissive) – 7 (extremely dominant) scale, how dominant they thought each face to be. Similar scales have been succesfully used in previous studies (Burriss & Little, 2006).

9.3.1.2 Analysis

For each participant, average dominance ratings were calculated for each of the eight types of faces: male faces with increased height, male faces with decreased height, female faces with increased height, female faces with decreased height, male faces with increased masculinity, male faces with decreased masculinity, female faces with increased masculinity, and female faces with decreased masculinity.

9.3.2 Results

A repeated-measures ANOVA was conducted analyzing the effects of transform type (perceived height vs. masculinity), degree of transform (-50% vs. +50%), and face sex (men vs. women) on dominance ratings. This analysis revealed a main effect of degree of transform ($F(1,22)=16.50$, $p<0.01$, $\eta_p^2=0.43$), but not transform type ($F(1,22)<0.01$, $p=0.93$, $\eta_p^2<0.01$) or face sex ($F(1,22)=0.03$, $p=0.88$, $\eta_p^2<0.01$) on dominance ratings. However, these main effects were qualified by the significant 3-way interaction among transform type, face sex, and degree of transform ($F(1,22)=10.49$, $p<0.01$, $\eta_p^2=0.32$). There was no between-subjects effect of participant sex on dominance ratings ($F(1,22)=0.33$, $p=0.57$, $\eta_p^2=0.02$), and no interactions between participant sex and transform type, degree of transform, or face sex (all $F(1, 22)\leq0.80$, all $p\geq0.38$, all $\eta_p^2\leq0.04$). Next, transform type and degree of transform were analyzed separately for each face sex to interpret the 3-way interaction among transform type, face sex, and degree of transform.

A 2x2 repeated-measures ANOVA for male faces showed that degree of transform had a significant effect on dominance ratings ($F(1,23)=12.09$, $p<0.01$, $\eta_p^2=0.34$), whereby amplifying perceived height and masculinity increased perceived dominance in male faces. Transform type did not affect dominance ratings ($F(1,23)=0.50$, $p=0.49$, $\eta_p^2=0.21$) and the interaction between transform type and degree of transform was not significant ($F(1,23)=1.65$, $p=0.21$, $\eta_p^2=0.07$). This latter result indicates that perceived height and masculinity transforms had similar effects on perceived dominance for male faces (Figure 9.3).

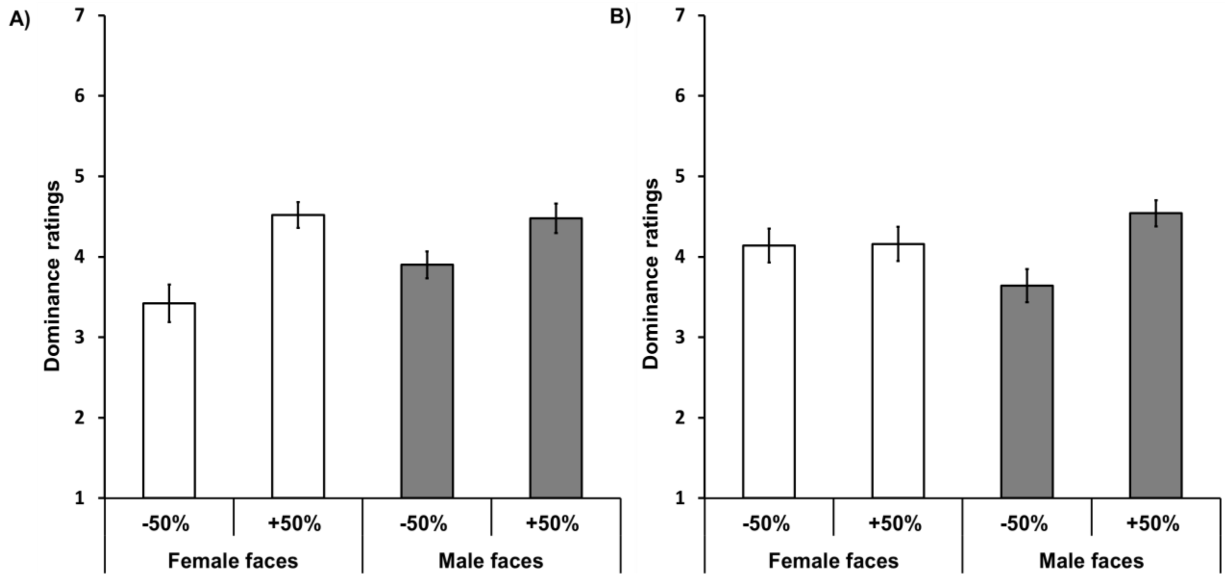

Figure 9.3. Mean dominance ratings and standard error for ±50% transforms in (A) perceived height and (B) masculinity in male faces (grey bars) and female faces (white bars). Perceived height increased perceived dominance in both sexes, while masculinity increased perceived dominance in male faces, but not female faces.

A 2x2 repeated measures ANOVA was also run for female faces. Degree of transform had a significant effect ($F(1,23)=12.91$, $p<0.01$, $\eta_p^2=0.36$) on dominance ratings. The main effect of transform type was not significant ($F(1,23)=0.88$, $p=0.36$,

η_p^2=0.04). The interaction between degree of transform and transform type was significant, however (F(1,23)=18.71, p<0.01, η_p^2=0.45). The effects of manipulating perceived height and masculinity in female faces were therefore analyzed separately. Paired-samples t-tests revealed that amplifying perceived height increased dominance ratings in female faces (t(23)=6.31, p<0.01, Cohen's d=2.63), while amplifying masculinity had no effect on dominance ratings in female faces (t(23)=0.12, p=0.78) (Figure 9.3).

9.4 Discussion

When altering the appearance of hypothetical leaders' faces, participants increased cues of perceived height more in the war context than the peace context. Masculinity was also increased more in the war context than the peace context, replicating results found in previous studies (Little, Burriss, et al., 2007; Spisak et al., 2012). Experiment 2 demonstrated that increasing perceived height increased perceived dominance in both male and female faces, while increasing masculinity increased perceived dominance in male faces (but not female faces).

Leadership quality perceived from faces may stem from impressions of dominance, reflecting the effect of physical stature on human social status and leadership selection (Murray & Schmitz, 2011; Riggio & Riggio, 2010). It follows that greater perceived dominance would be preferred in a leader when a group faces an outward threat. Previous research has found that greater facial and vocal masculinity is preferred in a leader when a group is in conflict with an external enemy (Little, Burriss, et al., 2007; Spisak et al., 2011; Tigue et al., 2012). Here we find that greater perceived height is also preferred in leaders during times of intergroup conflict. Height is a dominance cue that is salient in preverbal infancy (Thomsen et al., 2011), and taller athletes are more likely to be perceived as the aggressors in ambiguous physical contact in sports (van Quaquebeke & Giessner, 2010). Furthermore, taller men are more prone to acts of aggression (Archer & Thanzami, 2007), and taller people self-report more frequent dominant behavior (Melamed, 1992) than shorter people. The association between height and physical dominance, coupled with strengthened preferences for perceived height in leaders during time of intergroup conflict, provide further evidence that leadership perceptions from faces are based on cues to dominance.

Experiment 2 found that changes in perceived height and facial masculinity affect perceived dominance similarly in male faces, and perceived height has a greater impact on perceived dominance than masculinity in female faces. These results preclude the possibility that masculinity had a greater impact on perceived dominance than perceived height and thus required a smaller change to maximize perceived leadership ability. Instead, it appears that both perceived height and masculinity affect perceived dominance. Future research should therefore perhaps consider cues to perceived height when assessing dominance judgments from faces. It is important to note that social and physical dominance could be differentially affected by sexually selected traits (Puts et al., 2006). Future research could examine if perceived social and physical dominance have different effects on leadership judgments.

It is interesting to note that masculinizing female faces did not make them more dominant-looking. Previous studies have found that the effect of masculinization on perceived dominance is weaker in women’s faces than in men’s (Watkins, Jones, & DeBruine, 2010). Furthermore, dominance ratings correlate with upper body strength (a body indicator of physical dominance) in men’s faces, however this relationship does not exist in women’s faces (Gallup, O'Brien, White, & Wilson, 2010), and one study found that judgments of fighting ability from facial photographs images were less accurate for women's faces than for men's (Sell et al., 2009). Furthermore, judgments of women's dominance may be influenced by perceived social acumen more than judgments of men's dominance (Puts et al., 2006; Watkins et al., 2010), and feminizing (rather than masculinizing) women's faces increase perception of social dominance (Watkins, Quist, Smith, Debruine, & Jones, 2012). These studies indicate that facial masculinity plays a smaller role in judgements of dominance in female faces, a result replicated here. While masculinity was increased and decreased by 50% in the stimuli for the current study, it is possible that larger transformations may have greater effect on perceived dominance in women's faces.

One limitation of the current study is that facial cues to perceived height and masculinity may interact (manipulating perceived height may alter perceived masculinity and vice versa). Previous research has found that actual body height has an inverse relationship to perceived facial masculinity (Windhager et al., 2011), and that geometrically defined scores of facial masculinity have no relationship with body height or perceived height from face images (Chapter 7). While facial cues to perceived height and masculinity may not be entirely orthogonal facial parameters – indeed, men are taller than women in every culture studied (Eveleth, 1975; Gaulin & Boster, 1985) – the current results indicate that these cues have varying impacts on social judgments. In the peace condition in Experiment 1, facial cues were altered to increase perceived height but decrease masculinity in men's faces. Women's faces were altered to decrease masculinity, but were not altered in perceived height. Furthermore, the ±50% transformations in perceived height had a significant effect on dominance ratings in women's faces, while a similar transform in masculinity did not. While facial cues to perceived height and masculinity may interact, these results indicate that they are not perceptually equivalent. Future research could examine the perceptual relationship between facial cues to perceived height and masculinity.

The results of the current experiments potentially have implications in the political and business worlds. In both sovereign states and businesses where leaders are selected democratically, candidates' perceived attitudes toward external threats (rival countries or businesses) greatly influence voting behavior. While the body height of politcial and business leadership candidates are rarely depicted and are hard to estimate, their faces are constantly on display in the media and in campaign adverts. The current results suggest that candidates who appear to be taller have a distinct advantage in leadership decisions, especially during times when potential threat from an external force is perceived to be high. These results could be troubling for politcal scientists. Leadership decisions are especially important during times of external conflict, however the results of the current experiments suggest that leadership choices at these times are especially affected by face cues irrelevant to political expertise. The current results suggest that human groups turn towards their most dominant members for leadership when faced with an external threat, much as they appear to have done throughout evolutionary history (Murray & Schmitz, 2011; Riggio & Riggio, 2010).

Chapter 10: Conclusions

10.1 Summary of results

Chapters 4 and 5 demonstrated how two facial cues to body size, perceived height and facial adiposity, affect face attractiveness. In Chapter 4, we found that on average women preferred to enhance facial shape that increases how tall men were perceived to be, while men preferred to reduce the facial cues to perceived height in women's faces. Furthermore, women's preferences for facial cues to height correlated with their own height. These findings align with previous research done on preferences for body height (Higgins et al., 2002; Jackson & Ervin, 1992; Pawlowski, 2003; Salska et al., 2008; Shepperd & Strathman, 1989). Additionally, altering facial cues to perceived height affected perceived body height, and preferences for facial cues to perceived height were predicted by self-reported preferences for body height. These latter findings indicate that facial cues to perceived height are a reliably and consistently alter perceived height.

Chapter 5 examined the optimally attractive level of facial adiposity in women's faces before and after exposure to images of the bodies of light or heavy fashion models. The body mass index (BMI) level represented by facial adiposity preferences before exposure (19.6 kg/m^2) was similar to BMI preferences found for women's bodies (Tovee & Cornelissen, 2001; Tovee et al., 1999; Tovee et al., 1998). Exposure to heavy models increased preferred facial adiposity up to a level representing a BMI of 20.1, while exposure to light bodies did not significantly affect pre-exposure adiposity preferences. This study showed that facial adiposity, an established face proxy of body BMI (Coetzee et al., 2010) alters perceived facial attractiveness. Furthermore, preferences for facial adiposity are affected by exposure to images of the bodies of heavy female fashion models, a result that aligns with previous research that shows that exposure to non-face images can affect preferences for face cues (Little et al., 2011).

Perceived height and facial adiposity were established a reliable cues to facial attractiveness in Chapters 4 and 5. Research described in Chapters 6-8 assessed how these features affected perceived leadership ability. Chapter 6 examined the association between the optimal level of facial adiposity to maximize perception of attractiveness and leadership ability. The most attractive levels of facial adiposity (representing BMI values of 18.19 kg/m^2 and 22.46 kg/m^2 for women and men, respectively) were significantly lower than those chosen to maximize attractiveness (19.06 kg/m^2 and 23.59 kg/m^2 for women and men). These findings suggest that while facial attractiveness plays a role in perceived leadership ability (see Chapter 3), perceived leadership ability does not necessarily equate with attractiveness.

Chapter 7 presented a study examining how facial cues to perceived height affect perceived leadership ability. The first part of the study showed a strong correlation between perceived height and perceived leadership ability for faces of both men and women. A path analysis revealed that perceived height had a stronger relationship on perceived leadership ability than any other factor assessed, including facial width-to-height ratio and sex. A second study revealed that when altered in isolation, facial shape cues to perceived height are increased to maximize leadership perception. A morphometric analysis revealed that geometric face cues to sexual dimorphism were distinct from face cues associated with actual body height. While the morphological analysis did not investigate how geometric cues to *perceived* height and masculinity are related, it does indicate facial shape changes between men and women are not simply equal to those between taller and shorter people.

Chapter 8 described a study examining how facial cues to perceived height and facial adiposity affected perceived leadership ratings in unmanipulated three-dimensional faces. This chapter demonstrated that perceived height was correlated with perceived leadership ability in both men's and women's faces visualized in three dimensions, when extra face shape information (such as brow and jaw protuberance) is available. Chapter 6 demonstrated that facial adiposity levels representing BMI values of ~19 kg/m^2 (for women) and ~24 kg/m^2 (for men) were preferred for leaders. The results of Chapter 8 suggested that increase facial adiposity above a BMI value of 25 kg/m^2 reduced perceived leadership ability, demonstrating that overweight people suffer disadvantages in leadership selection even when limited to exposure of face images alone.

Chapter 9 examined how facial cues to perceived height were differentially preferred in leaders' faces in times of war and peace. These results extend the findings for masculinity preferences in leaders' faces (Little, Burriss, et al., 2007) and suggested that facial cues to perceived height may alter perception of dominance. Supporting this, faces increased in perceived height shape were found to be more dominant looking than those reduced by in perceived height shape.

10.2 The role of perceived height and facial adiposity on attractiveness and leadership judgments

Facial cues to perceived height were found to influence attractiveness and perceived leadership ability. While increasing perceived height enhanced both attractiveness and leadership ability, it is important to note that these two attributions were not equivalent. In Chapter 4, female participants increased perceived height by an average of 15.32% and male participants by 21.15% to maximize attractiveness. Study 2 in Chapter 7 used the same interactive transforms, and participants increased perceived height shape by 44.8% to maximize perceived leadership ability. Chapter 4 found that facial adiposity affects perceived facial attractiveness judgments, and Chapter 6 demonstrated differences in optimal facial adiposity for attractiveness and leadership judgments.

It is likely that the discrepancy between attractiveness and leadership preferences is due to the role of facial dominance in leadership judgments. As Chapter 3 discussed, face judgements of leadership are positively associated with perceived dominance. Thus, the most attractive face may not be the one perceived as best leader. Indeed, perceived height and facial adiposity are both perceptually linked to body size, a good indicator of dominance (see Chapter 1), and the most leader-like face was both taller and heavier-looking than the most attractive face. Chapter 9 demonstrated that perceived height does have a strong relationship with perceived dominance. It is likely that facial adiposity also influences perceived dominance, with the most physically dominant individuals having a BMI at the high end of healthy (though BMI levels above 25 kg/m^2 are unhealthy and therefore less dominant, a trend likely contributing to faces of overweight people having lower leadership ratings in Chapter 8).

10.3 Future work

Leadership judgments across cultures

The experiments described in Chapters 4-9 used primarily Caucasian face stimuli which were mostly rated by participants in the western world. Previous research has shown that even though individuals across cultures agree on personality judgments from faces, such as dominance and warmth, they do not agree on leadership judgments (Rule et al., 2010). Indeed, preferred personality attributes in leaders differ across cultures with western cultures preferring dominant leaders and Asian cultures preferring more approachable and reserved leaders (Den Hartog et al., 1999). Facial cues to body size influence perceived dominance and are therefore a factor in leadership judgments in western cultures. It is unclear, however, whether perceived height and facial adiposity would have such an effect for other cultures where leader dominance is less emphasized. It is possible these cues have little to no impact on leadership choices in these cultures. More likely, however, facial cues to perceived height and adiposity would still influence leadership judgments, but may take a secondary or tertiary role after attributions of greater importance to that culture, such as perceived warmth and approachability. Future research could expand upon the studies described in this thesis by investigating how perceived height and adiposity influences leadership judgments using face stimuli and participants from various cultures.

Leadership judgments in other social contexts

Chapter 9 examined how social context affected preferences for perceived height in leaders' faces. This study used conditions of war and peace, following established methods (Little, Burriss, et al., 2007; Little et al., 2012). Other studies have examined masculinity preferences in leaders' faces when intergroup conflict or within-group cooperation was emphasized, and found similar results to the war and peace contexts (Spisak et al., 2012; Spisak et al., 2011). War and peace contexts were used to evoke dominance preferences in leaders in Chapter 9, however most issues that organizational leaders face are not so extreme. For example, business leaders do not face war, but do compete with other organizations in the same market. It would be interesting to determine whether the facial traits preferred in leaders when specifying armed conflict would also hold for business leaders trying to lead their organization to financial gain over rival companies. It is possible that the very nature of competitive interaction is enough to induce preferences for dominant-looking leaders. It is also conceivable that the dominance preferences evoked by the context of war, a violent conflict between countries, would not be nearly as strong for the less violent business world. Furthermore, there are many complex social circumstances that leaders face (i.e. – financial hardship, subordinate dissatisfaction, etc.), and most leaders need to deal with several complex situations simultaneously. Future research could assess how facial cues to perceived height or adiposity are differentially preferred across several basic leadership contexts unrelated to intergroup threat.

Perceived height and facial adiposity in real-world leaders

The research in this thesis has demonstrated that people who appear to be tall and in a healthy weight range from their face images are perceived as good leaders. Previous research has demonstrated that not only does physical body size affected leadership judgments, but positions in leadership hierarchies influence perception of body size. For example, Higham and Carment (1992) demonstrated that political candidates are perceived as taller after winning elections than beforehand, while other candidates are perceived as shorter after losing an election. It would be interesting to create an experiment in which participants are allowed to manipulate well-known politicians' faces in perceived height or adiposity before and after an important election. Participants would be asked to manipulate such faces to match what the real politician's face looks like. It is possible that participants would be more likely to manipulate successful candidates' faces to make them taller or more within a healthy weight range than they really are. Likewise, faces of losing candidates may be manipulated to look shorter or heavier than they really are. The principal behind this idea could also be tested for politicians in office during times of high and low popularity. If successful/popular politicians were made to look taller and healthier than in reality, while unsuccessful/unpopular candidates were made to look shorter and heavier (or possibly underweight), it would demonstrate that the association between perceived height and facial adiposity and leadership ability is not unidirectional, but that altering one side of the relationship will affect the other.

Facial cues to perceived leadership and real-world leadership success

The experiments reported in this thesis, and the majority of research on facial cues to leadership, focus on perceived leadership ability, not actual measures of leadership success. Recently, however, several studies have reported correlations between perceived face attributions and real-world leadership success (as measured by company profits; Rule & Ambady, 2008, 2009, 2011a, 2011b). Taller people have been found to earn higher incomes (Case & Paxson, 2008; Judge & Cable, 2004), while heavier people are more likely to be of lower socioeconomic status (Sobal & Stunkard, 1989). It is therefore conceivable that facial cues to perceived height and facial adiposity may predict leadership success as defined by financial profits in the business world. There are several measures of political leadership performance as well. Future research could focus on how perceived height and adiposity, and perceived leadership ability in general, correlates with actual leadership success.

10.4 Conclusions

Research on how facial appearance influences leadership selection has largely focused on the effects of two main facial cues: attractiveness and perceived dominance.

As described in Chapter 3, facial attractiveness is positively correlated with perceived leadership ability in both hypothetical voting situations and real-world elections. Several studies have demonstrated that perception of dominance is also positively correlated with experimental and real-world voting behaviour.

While numerous studies have investigated the independent effects of attractiveness and dominance on perceived leadership ability, no theories were put forth to examine possible links between these explanatory variables. Two basic body size parameters, height and weight, have great effects on both attractiveness and perceived dominance (Melamed, 1992; Pawlowski, 2003; Tovee et al., 2006). Furthermore, physical body stature has been demonstrated to influence perceived leadership ability (Murray & Schmitz, 2011). Given the links between facial appearance and leadership selection, as well as body size and leadership selection, the goal of this thesis was to examine whether there were perceptible facial cues to body size and to determine if they influence perceived leadership ability. The experimental chapters of the thesis assessed whether two recently-discovered facial cues, perceived height and facial adiposity, could provide an explanatory link between influence attractiveness, dominance and leadership selection.

The results of Chapters 4-9 indicate perceived height and facial adiposity influence attractiveness and perceived dominance. Furthermore, these facial cues have strong and robust effects on perceived leadership ability. Previous studies on facial cues to leadership have mostly focused on correlations between leadership selection and perceptual ratings of faces, including attractiveness, dominance and maturity. Very few studies have assessed measurable facial dimensions that affect leadership perception (with the exception of facial masculinity; Little et al., 2007).The results found in this thesis reveal two quantifiable face parameters that affect perception of attractiveness, dominance and leadership ability. These studies reported in Chapters 4-9 revealed that perceived height and facial adiposity can be manipulated to alter perceived attractiveness, dominance and leadership ability in a predictable manner, thereby extending beyond prior studies that examine correlations between facial attributions (i.e. – competence) and leadership selection.

The results reported in this thesis suggest a new direction for research on facial cues to perceived leadership ability. While previous studies have examined how social attributions drawn from face images correlate with how good a leader someone appears to be, future studies can now form testable hypotheses based on face manipulations of perceived height and facial adiposity. While perceived attractiveness and dominance were considered as separate aspects of perceived leadership ability, perceived height and facial adiposity influences both judgments. The studies in this thesis have broadened the horizons of leadership research by revealing the links between facial appearance, body size, and leadership perception which draw upon modern day stereotypes based on historical associations between size and rank. Future studies on perception of leadership ability could thus focus on the measurable face cues reported in this thesis which encompass the social attributions that were previously the strongest predictors of leadership selection. The results of the studies in this thesis and the new directions this research has made possible have implications in business and politics, and could be of importance to anyone with an interest in face perception, human social interaction, or the democratic selection of leaders.

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Appendix A: Ethics forms