Appearance and Physiognomy

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Introduction

The face may be the richest source of nonverbal human communication. Facial appearance purveys reliable information about a diverse array of human characteristics, from one's health and quality as a potential mating partner to complex cognitive states and traits such as one's emotions, attitudes, and propensity for particular behaviors. The face plays such an enormous role in social interaction that the human brain contains regions in the visual system that may specialize in processing facial stimuli (Hadjikhani, Kveraga, Naik, & Ahlfors, 2009; Kanwisher, Chun, & McDermott 1997; Sergent, Ohta, & Macdonald, 1992). Indeed, humans selectively attend to faces over other types of stimuli (Ro, Russell, & Lavie, 2001; Theeuwes & Van der Stigchel, 2006) and even infants prefer face-like stimuli over other visual patterns as early as their first few minutes after birth (Goren, Sarty, & Wu, 1975).

Faces have an immense impact on human life, and so it may come as no surprise that an entire field of scientific research is dedicated to uncovering the plethora of effects that facial appearance has upon social functioning. The following chapter will discuss the current state of several fields of face research. We will examine the multi-faceted nature of facial attractiveness, including contemporary theories on the facial characteristics that influence perceptions of beauty. We will then visit the ancient topic of physiognomy – the art of evaluating personality from facial appearance – and detail the resurgence of this field in the studies of contemporary researchers. The following section analyzes the validity of face research using two-dimensional images and compares results to recent studies using video stimuli and three-dimensional face image software. Finally, we will discuss some new directions in face research at the helm of taking physiognomy to places never previously considered (please see Chapter 10 for discussion of research on facial morphology and expressions).

Facial attractiveness

Physical attractiveness, or beauty, influences almost every aspect of human social life. Although one may like to think that attractiveness holds no advantages here in the 21st century, this is not the case. In fact, it can be alarming just how far the effects of attractiveness pervade society. It may not be surprising that attractive people are more strongly desired as sexual partners or spouses (Buss & Barnes, 1986). What is surprising, however, is that attractive people are viewed more favorably elsewhere as well – attractive students are viewed as more competent by teachers (Ritts, Patterson, & Tubbs, 1992), attractive people are more likely to be hired for jobs (Toledano, 2013), attractive employees are given better performance reviews and earn higher incomes (Mobius & Rosenblat, 2006; Toledano, 2013), attractive political leaders gain more electoral votes (Banducci, Karp, Thrasher, & Rallings, 2008; Berggren, Jordahl, & Poutvaara, 2010; King & Leigh, 2009), and so on. In fact, attractive people are viewed more positively, in general, a phenomenon known as the "attractiveness halo effect" (Dion, Berscheid, & Walster, 1972).

Given the effects of attractiveness in society, it is no surprise that facial attractiveness has been the focus of a wealth of empirical research. Studies on facial attractiveness continue unabated to this day, with state-of-the-art face-processing technology providing researchers with a closer look at facial features and characteristics that affect how attractive a person looks. Certain aspects of facial attractiveness are specific to a particular geographic region or culture. For example, it is not uncommon to see deliberate facial disfigurements in particular cultures; for example, teeth blackening as a practice among some peoples in Borneo; the traditional insertion of large lip plates among the Sara people of Central Africa; or even the facial piercings that frequently adorn the faces of North American youth. The effects of these external adornments on

social perception can be significant, and may vary by temporal, geographic, or cultural norms (Cash, Dawson, Davis, Bowen, & Galumbeck, 1989; Mulhern, Fieldman, Hussey, Lévêque, 2003; Secord, 1958).

However, there are many natural facial characteristics that have documented effects on perceptions of attractiveness across cultures. This chapter will focus on these aspects of attractiveness. Given their universal nature, it is perhaps natural to think that these elements provide some insight to a person's potential quality as a mating partner. After all, why would an aspect of appearance influence how attractive somebody is perceived if that feature was meaningless as a depiction of mate quality? The following section will discuss research on several facial characteristics that influence attractiveness and will evaluate theories of why these features may affect perceptions of mate quality.

Skin condition

It may seem obvious that skin condition should have a great effect on how attractive a face appears. After all, the skin covers the surface of the face, and it would be very difficult to make attractiveness judgments based on face shape and structure while disregarding the appearance of the skin. Surprisingly, though, skin condition has not received as much empirical attention as other aspects of facial attractiveness, such as averageness, symmetry, and dimorphism (discussed later in this section). Skin condition has an influence on perceptions of age and health (Barber, 1995), whereas skin abnormalities such as lesions and growths may indicate poor health or a compromised genetic disposition (Symons, 1995).

A homogeneous distribution of skin color across the face enhances attractiveness such that faces with evenly distributed coloration appear younger and healthier than those with more variation in their coloring (Fink, Grammer, & Matts, 2006; Matts, Fink, Grammer, & Burquest,

2007). In fact, increasing color homogeneity can make a face appear five years younger (Fink & Matts, 2008) and applying the difference in skin color between groups of younger and older adults to a single face alters perceived age accordingly (a process known as "transforming" that is often done with computer software in face perception studies; similar transformation techniques can manipulate any specified face characteristic and will be discussed throughout this chapter). Skin texture also impacts attractiveness such that people with greater homogeneity in skin texture are perceived to be better looking (Fink, Grammer, & Thornhill, 2001). When researchers increase skin color homogeneity along with skin topography homogeneity (e.g., the evening out of wrinkles), age perceptions can decrease as much as fifteen years (Fink & Matts, 2008). These studies suggest that the distribution of skin color and texture alone affect face perception – homogeneous skin color and texture across a face make a person appear younger, healthier, and more attractive.

Previous studies have examined the role of skin color distribution on attractiveness. The specific coloration that affects attractiveness, however, is a topic of recent burgeoning interest. So far, researchers have identified three main color components of attractiveness: redness, yellowness, and lightness (Stephen, Smith, Stirrat, & Perrett, 2009). Skin color and reflectance can be measured electronically using calibrated spectrophotometers under standardized lighting conditions, recording separate values for redness, yellowness, and lightness. Skin redness is indicative of oxygenated blood levels that increase with respiratory health (Armstrong & Welsman, 2001). High physical fitness increases skin redness (Johnson, 1998), as does estrogen in women (Thornton et al., 2006). There is evidence that testosterone increases skin redness in some non-human primate species as well (in rhesus macaques, Rhodes et al., 1997; in male mandrills, Setchell & Dixson, 2001). Thus, high levels of redness in the skin may indicate high

mate quality, as suggested in the handicap hypothesis (Folstad & Karter, 1992) discussed in more depth below. In contrast, high levels of deoxygenated blood give the skin a bluish color associated with cardiac and respiratory illness (Ponsonby, Dwyer, & Couper, 1997). Skin redness therefore acts as an indicator of health and mate quality. When given the chance to transform face redness in a realistic fashion (simulating blood oxygenation levels) to optimize perceived health, participants in one study increased oxygenated blood levels for 98% of all faces (Stephen et al., 2009). It should be noted that participants increased redness to a realistic point, as increasing redness to too great a degree decreases perceived health. Furthermore, participants increased redness more for faces that were lower in starting redness. Preferences for skin redness are not simply a preference for the color red (such as seen in clothing preferences; Beall & Tracy, 2013; Elliot et al., 2010; Elliot & Niesta, 2008) but, rather, seem to reflect coloration indicative of high cardiovascular fitness (Re, Whitehead, Xiao, & Perrett, 2011; Stephen et al., 2009).

Skin yellowness is altered by carotenoid consumption and melanin (Edwards & Duntley, 1939; Stamatas, Zmudzka, Kollias, & Beer, 2004). Carotenoid pigmentation affects the dermis, thus skin yellowness directly reflects carotenoid level. 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). For example, those afflicted with HIV or malaria have low carotenoid levels (Friis et al., 2001). Carotenoid levels are depleted in fighting and averting illness, thus skin yellowness is an indicator of current immunological capacity. As with redness, participants in face perception studies increase yellowness to make a face appear healthier and more attractive (Stephen, Coetzee, Smith, & Perrett, 2009). One recent study examined how real facial skin coloration is altered with changes in carotenoid consumption over a six-week period, revealing

that an increase in carotenoids equivalent to an extra 3.3 portions of fruits and vegetables a day was enough to make participants reliably more attractive (Whitehead, Re, Xiao, Ozakinci, & Perrett, 2012). The effects of skin yellowness and carotenoid consumption on facial attractiveness have been replicated in groups with different basal skin tone levels (Caucasians, Asians, and Africans) and across cultures (Coetzee et al., 2009; Whitehead, Coetzee, Ozakinci, & Perrett, 2012).

The third skin color component that affects attractiveness is lightness (think pale versus tanned skin). Skin lightness is primarily affected by melanin, with higher melanin pigmentation making skin darker (but also making skin yellower). Melanin protects from ultraviolet (UV) radiation by filtering UV rays, reducing the probability of developing skin cancer and sunburn (Robins, 1991). Melanin also helps prevent pregnancy defects in women (Omaye, 1993). High melanin levels incur a health cost, however, as melanin's UV-filtering properties inhibit vitamin D synthesis, which could lead to bone-related deformities (Jablonski & Chaplin, 2000). In general, women have lighter skin than men (Edwards & Duntley, 1939; Vandenberghe & 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 increased skin lightness (simulating lower melanin levels) to optimize perceptions of health. In accordance with natural color dimorphism, participants lightened female faces more than male faces. Preferences for light skin in women have been found across cultures (Coetzee et al., 2012; Vandenberghe & Frost, 1986), and may reflect the need for increased vitamin D synthesis (Jablonski & Chaplin, 2000).

As described above, skin condition has a great impact on attractiveness, and it is easy to understand why. Skin condition is indicative of current cues to *actual* physical health such as

cardiovascular fitness and carotenoid level. Unlike other elements of attractiveness that we will visit later (averageness, symmetry, dimorphism), skin condition is strongly related to *perceived* health (Jones, Little, Burt, & Perrett, 2004; Stephen et al., 2009). Furthermore, unlike face structure, skin condition is plastic and reflects *current* health, not just genetic stability or hormonal status during embryonic development or puberty. All of these factors make studies on skin condition an exciting aspect of face perception research. In fact, studies on skin condition are a good example of face research with direct application to real life. Recent findings on how cardiovascular fitness and fruit and vegetable consumption affect attractiveness provide added incentives for people to exercise and practice a healthy diet—lifestyle changes that could increase individuals' health and have an impact on national healthcare costs (Whitehead, Ozakinci, & Perrett, 2012).

Averageness

Galton (1878) first noted that superimposing images of individual faces created a composite face that was more attractive than any of the component faces. More than one-hundred years later, digital face-processing technology has allowed for this hypothesis to be tested experimentally. Langlois and Roggman (1990) were among the first to examine whether average faces were attractive. They produced averages of groups of 8, 16, or 32 individual faces and found that the resultant faces were indeed more attractive than their constituents. It was hypothesized that facial composites were similar to a mental template of a face, or more "facelike," without any of the irregularities that can be found in an individual face (Langlois & Roggman, 1990). If this theory were true, it would mean that a face could not get more attractive than the most average configuration for a population. Over time, the idea that average facial

configurations are the most attractive came to be known as the "averageness hypothesis" (Perrett, May, & Yoshikawa, 1994; Valentine, Darling, & Donnelly, 2004).

Technological problems can arise when averaging faces with computer software, as averaged skin complexions are smoother (and therefore found to be more attractive for the reasons discussed above; Benson & Perrett, 1992) and because averaged faces will not show the effects of any asymmetries present in an individual face (Alley & Cunningham, 1991). However, averaged faces are more attractive even when skin texture is held constant (Little & Hancock, 2002), and line-drawings tracing the features of averaged faces (and thus not depicting skin texture at all) are more attractive than line-drawings of non-average faces (Rhodes & Tremewan, 1996). Furthermore, increasing averageness boosts attractiveness even when symmetry is digitally controlled (Jones, DeBruine, & Little, 2007; Rhodes, Sumich, & Byatt, 1999) and average face configurations are more attractive than non-average faces even when only side-views (which do not allow for evaluations of symmetry) are observed (Valentine et al., 2004). These findings suggest that the effect of averageness on attractiveness cannot be explained by skin texture or symmetry alone; indicating that averageness itself does contribute independently to facial beauty (see Figure 1).

Please insert Figure 1 about here

It is important to note that, although average faces are attractive, the *most* attractive faces are not average (DeBruine, Jones, Unger, Little, & Feinberg, 2007). If an average face configuration was most attractive, the average of an entire population should be more attractive than the average of any smaller subset from the same population. A face averaged from a particular population, however, can be made more attractive by transforming that face towards

the configuration of the most attractive subset of the same population (DeBruine, Jones, Unger, Little, & Feinberg, 2007). This is true even if the same transformation makes the face appear less average-looking. On some level, this is intuitive: the most attractive face should not just be mathematically average but, rather, should have some features that catch the eye and distinguish it from other faces in one's environment. Facial characteristics that are perceived as most attractive when not in an average configuration, such as skin color, adiposity, and masculinity, are discussed elsewhere in this chapter.

Despite the fact that an average face is not necessarily the *most* attractive face possible, a wealth of empirical evidence supports the fact that facial averageness is certainly attractive. Why should this be the case? It is possible that facial averageness is a cue to a healthy genetic composition. Abnormalities in the face decrease averageness; they are the opposite of average. Increased sexual dimorphism (discussed below) may raise attractiveness beyond an average face configuration, possibly acting as a cue to high immunocompetence (that is, the ability to respond normally to pathogens). However, non-average features that are not due to dimorphic growth may be a cue to poor genetic quality. Even minor abnormalities may indicate instability in embryo development (Hoyme, 1994). Face abnormalities can indicate poor health (Symons, 1995), thus facial averageness may represent a lack of health problems.

Despite this theoretical link, however, few studies have examined the link between facial averageness and real measures of health. Ratings of facial distinctiveness (the opposite of attractiveness) are negatively correlated with perceptions of health (Rhodes et al., 2001). Furthermore, ratings of the distinctiveness of 17-year-olds' faces were found to correlate with measures of poor childhood health in men and poor current health in women, though these correlations were moderate in size (r = -0.28 and -0.25, respectively; Rhodes et al., 2001). Thus,

although the relationship between facial averageness and health is somewhat unclear, there is little question that averageness does influence attractiveness. Future studies should be conducted to elucidate the proximate cause for the relationship between averageness and attractiveness.

Symmetry

In human anatomical terms, symmetry refers to similarity of features across the median sagittal plane of the body. Asymmetry can be considered 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 a characteristic that is symmetric across a population, but varies across individuals (Palmer & Strobeck, 1986; Thornhill & Gangestad, 1996). The term "fluctuating" is slightly misleading, as anatomical symmetry does not fluctuate within an individual (barring some external force like surgery or traumatic injury); rather, the degree of symmetry of a particular characteristic may fluctuate across a population. For example, eye size for the left and right eyes is symmetric across a population, and any asymmetry in this trait in an individual would represent fluctuating asymmetry. Fluctuating asymmetry is thought to reflect developmental stability and is thus an indicator of mate quality (Gangestad & Simpson, 2000; Moller & Thornhill, 1998). In this chapter, "symmetry" will refer exclusively to fluctuating asymmetry.

Early studies on facial symmetry found preferences for asymmetrical faces (Kowner, 1996; Langlois, Roggman, & Musselman, 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. 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, they were able to alter facial symmetry without creating the odd appearance found in chimeras. Thus, they found that more structurally symmetrical faces were perceived to be more attractive than faces with lower structural symmetry; and structurally symmetrical faces have been found to be preferred in both natural and digitally manipulated faces (Gangestad, Merriman, & Emery Thompson, 2010; Little, Jones, Burt, & Perrett, 2007; Penton-Voak et al., 2001), a preference that is retained across cultures (Little, Apicella, & Marlowe, 2007).

Face symmetry has been found to positively correlate with perceived health (Jones et al., 2004; Rhodes et al., 2001, though see Gangestad, Merriman, & Emery Thompson, 2010). Women's preferences for symmetry correlate with their own perceptions of attractiveness (Little, Burt, Penton-Voak, & Perrett, 2001) and are higher during the fertile phase of their menstrual cycle when judged in a short-term relationship context, but not in a long-term context (Little & Jones, 2012). These results demonstrate that facial symmetry may be indicative of heritable benefits to offspring (i.e., "good genes") that are more appealing to women when they are more likely to conceive (and thus benefit from the mate quality of their sexual partner).

The studies mentioned above suggest that symmetry is indicative of health and genetic quality. Much like averageness, facial symmetry may serve as a cue to developmental stability. However, whereas facial asymmetries may be associated with chromosomal disorders (Hoyme, 1994), self-reported respiratory illnesses (Thornhill & Gangestad, 2006), and measures of

oxidative stress (Gangestad, Merriman, & Emery Thompson, 2010), several studies have failed to find relationships between symmetry and health (Honekopp, Rudolph, Beier, Liebert, & Muller, 2007; Rhodes et al., 2001; Tomkinson & Olds, 2000). Other studies have found correlations between symmetry and self-reported health, but the relationships have been weak or have failed to replicate (Hume & Montgomerie, 2001; Shackelford & Larsen, 1997). It is odd that symmetry should have such an effect on attractiveness yet few discernible links to health. It is possible that symmetry had a much stronger relationship with health in more ancient times, and that modern medicine has weakened that relationship (Rhodes, 2006). However, more research needs to be conducted to determine any possible connection (past or present) between symmetry and health. Whatever that connection may be, it is clear that symmetry does have an influence on facial attractiveness, preferences for partners, and perceptions of health - with more symmetrical faces appearing more attractive, more preferred, and belonging to healthier people.

Facial adiposity

Adiposity (defined as "the perception of weight in the face"; Coetzee et al., 2009, p. 1701) is among the most recent face characteristics discovered to have a profound effect on attractiveness. Although body weight has a well-documented relationship with body attractiveness, facial cues to body weight were not empirically analyzed until recently. Coetzee, Perrett, and Chen (2009) first examined facial adiposity as an accurate cue to body weight. They found that weight judgments made from face images alone (or perceived facial adiposity) were an accurate predictor of actual body mass index (BMI; a measure of body weight scaled for height). Later studies quantified measureable dimensions associated with perceived facial adiposity and 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 (Coetzee, Chen,

Perrett, & Stephen, 2010). 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.

Early research found that facial adiposity reflects actual BMI, and other studies revealed that it has effects on perceived attractiveness and health. One study revealed that ratings of facial adiposity predicted both perceived attractiveness and perceived health in a quadratic pattern (i.e., faces rated as average weight were perceived as healthier and more attractive than those rated as underweight or overweight; Coetzee et al., 2009). These results demonstrate that facial adiposity is not only an accurate predictor of actual BMI, but that it also alters the perception of attractiveness and health, and predicts actual health measures. More recent studies have given participants the chance to alter facial adiposity in order to maximize the perceived health and attractiveness of given faces. Facial adiposity transforms of individual faces can be made using "prototypes" (averaged faces used as template-based reference points for the transformation of individual faces). Because the BMIs of the individuals used to create the prototypes are known, and the average BMI for the prototypes can be computed, the resulting BMI of an individual face after transformation can be also calculated (Figure 2). One study of British participants found that women 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 (Coetzee, Re, Perrett, Tiddeman, & Xiao, 2011). These BMI values were significantly different, indicating that women show a disparity in what they believe to be most attractive and most healthy in terms of facial adiposity (at least in Britain). 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. This

study indicates that women have different ideas about what looks healthy and what looks attractive in other women, a disparity possibly caused by the unhealthily thin body ideals portrayed in female-targeted media (Coetzee et al., 2011). Preferences for low facial adiposity were also found among a sample of South African women (Coetzee et al., 2012), demonstrating cross-cultural consistency in adiposity preferences. As Coetzee et al. (2012) note, however, South African university students are considered among the "African elite," and so preferences for low adiposity may not extend across all of Africa. Indeed, the optimally attractive body weight is reported to be higher for rural South Africans than in western countries like the UK; however, South Africans' preferences for body weight were found to converge with typical western preferences after immigrating to the UK (Tovée, Swami, Furnham, & Mangalparsad, 2006).

Please insert Figure 2 about here

Much like skin condition, adiposity may serve as a criterion for mate choice through its reflection of actual current health. Ratings of facial adiposity correlate linearly with the self-reported frequency of respiratory infections and antibiotic use (Coetzee et al., 2009) as well as physical ailments such as a running and congested nose, diarrhea, nausea, and headaches (Tinlin et al., 2012). The relationship between adiposity and health also appears to remain constant across time: one study showed that ratings of adiposity from high school yearbook photographs predicted individuals' future weight and measures of health problems later in life, as well as higher mortality rates (Reither, Hauser, & Swallen, 2009). Furthermore, facial adiposity may be associated with mental health problems, as higher adiposity was found to correlate with self-reported stress, anxiety, depression and negative mood in women (Tinlin et al., 2012). New

studies have found that facial adiposity is negatively correlated with immunocompetence (as measured by levels of hepatitis B antibody produced in response to a hepatitis B vaccination; Rantala et al., 2013) and that adiposity mediates the relationship between attractiveness and immunocompetence. These studies indicate that adiposity serves as a cue to attractiveness via its strong relationship with health and immunocompetence—a heritable genetic trait that can be passed to offspring.

Sexual dimorphism

The role of sexually-dimorphic face shape on attractiveness has been one of the most interesting and complex relationships studied in face perception research. Sexual dimorphism 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, we will discuss each sex separately.

Femininity in women's faces. Facial femininity is characterized by large eyes, full lips, a small and pointed chin, and high cheek bones (Figure 3). Estrogen, the primary female sex hormone, is largely responsible for the development of feminine facial features by inhibiting the masculinizing effects of testosterone, as described below. Law-Smith et al. (2006) found that facial femininity correlated with levels of circulating estrogen for women in the late-follicular phase of their menstrual cycle. Estrogen has been linked to higher success rates in conceiving (Lipson & Ellison, 1996); thus facial femininity may indicate higher reproductive potential in women.

Please insert Figure 3 about here

The relationship between women's facial femininity and facial attractiveness is clear: femininity, as rated by men and women, 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. 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 then, several studies have demonstrated that a facial structure that is more feminine than average is attractive in female faces (Cunningham, 1986; Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Lee et al., 2013; Koehler, Simmons, Rhodes, & Peters, 2004; Rhodes, Hickford, & Jeffery, 2000; see Jones, 2014 for review).

Masculinity in men's faces. Testosterone, the primary male sex hormone, has been theorized to have 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 man (Zahavi, 1975), and thus only the men with the highest genotypic quality can develop these features. This "handicap hypothesis" (Folstad & Karter, 1992) states that displays of high testosterone in men indirectly indicates genotypic quality by signaling 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, which plays a significant role

in mating success for many mammalian 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 characterized by several traits, including a prominent brow ridge, a 'squared' jaw, and high cheek bones (Fink & Penton-Voak, 2002; Miller & Todd, 1998; Figure 3). Men with high testosterone levels (as measured from saliva samples) are rated as more masculine (Penton-Voak & Chen, 2004), and, behaviorally, men with high testosterone smile less than those with low testosterone (Dabbs, 1997). Likewise, men with higher facial masculinity show relatively higher increases in testosterone after competition (Pound, Penton-Voak, & Surridge, 2009). Furthermore, perceptions of masculinity drawn from men's faces correlate with actual grip strength (Fink, Neave, & Seydel, 2007). Findings like these indicate that 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 less straight-forward (see DeBruine, 2014 for review).

Though the handicap hypothesis suggests that women should prefer men with higher testosterone levels, empirical data on the issue have shown disparities. Perrett et al. (1998) found that women prefer feminized men's faces in both 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, however (Cunningham, Barbee, & Pike, 1990; Grammer & Thornhill, 1994; Scheib, Gangestad, & Thornhill, 1999) and yet other studies have found no general preference for measures of facial masculinity or femininity in men's faces at all (Koehler, Simmons, Rhodes, & Peters, 2004; Lee et al., 2013; Swaddle & Reierson, 2002; Thornhill & Gangestad, 2006).

The high amount of variation in women's preferences for men's facial masculinity may arise from the differential benefits attributed to masculine and feminine faces. Whereas a masculine face structure may be a cue to heritable genetic benefits, masculinity is also linked to undesirable personality traits and aggressive behavior, both perceptually and in real life (this topic will be revisited later). Furthermore, men with high testosterone may be more able to attract mates, and have been found to show lower levels of self-reported monogamous relationship commitment in the real world (Booth, Mazur, & Dabbs, 1993; Burnham et al., 2003; Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002). Feminine facial characteristics in men correlate with perceptions of positive personality traits, such as higher parental investment and faithfulness (Boothroyd, Jones, Burt, & Perrett, 2007; Perrett et al., 1998). Thus, men's facial masculinity and femininity are associated with very different personality attributions and real-world behavior. These differential benefits may explain some of the variation in women's preferences for men's facial dimorphism (a notion described as "Trade-off theory"; Gangestad & Simpson, 2000).

Masculinity preferences may also vary by context. Women seem to prefer masculine male faces when "good genes" (as exhibited by a resistance to the immunosuppressive effects of testosterone) may take priority over desirable personality traits. For example, 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 paternal 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 (Gildersleeve et al., 2013; Gildersleeve, Haselton, &

Fales, 2014; Jones et al., 2008; Little & Jones, 2012; Penton-Voak et al., 1999; though see Harris, 2011; 2013), and are reduced before puberty and after menopause (Little et al., 2010). Likewise, preferences for feminine male faces 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 mate) 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, such as rural Jamaica (Penton-Voak, Jacobson, & Trivers, 2004), suggesting that women select mates for genetic benefits when male commitment is unlikely. Masculinity preferences have also been shown to correlate with indices of women's sensitivity to pathogen-related disgust (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010; as measured by the three-domain disgust scale, Tybur, Lieberman, & Griskevicius, 2009), and increase in areas with less access to medical care (Penton-Voak et al., 2004), perhaps due to the immunocompetence benefits associated with masculinized features. 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, such as an image of a bodily fluid on a white cloth (Little, DeBruine, & Jones, 2011). More recent work has also demonstrated that women's preference 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 and wealth

(when wealth is in abundance, women 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 to cues suggesting different environmental and social contexts.

With masculinity preferences being so highly variable, one must wonder what masculinity indicates in terms of mate quality. As mentioned, 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) but 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 of face shape) 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. More recently, Gangestad, Merriman, and Emery Thompson (2010) found that women's ratings of men's facial masculinity was positively related to attractiveness, and was inversely related to measures of oxidative stress.

Although preferences for facial masculinity are thought to reflect predilections for indicators of heritable immunocompetence based on displays of testosterone-related development, 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 suppresses the immune system. They discovered that testosterone levels had no influence on rated attractiveness; however, faces of people with low cortisol levels were rated as more attractive than those with high cortisol levels. Moore et al. (2011b) extended upon this study by finding that the effects of cortisol on attractiveness were reduced when testosterone levels were high. They argued that testosterone affects facial attractiveness indirectly by moderating the effects of cortisol on attractiveness. Furthermore, one study found that preferences for low cortisol were ubiquitous across 13 countries, whereas preferences for high testosterone were only present in countries with high human development index scores (HDI; a scale of societal development in which higher scores indicate a lower standard of living) such as Cameroon and Namibia (Moore et al., 2013). 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. Moreover, another recent study found that facial adiposity, not masculinity, mediated the relationship between facial attractiveness and immunocompetence (Rantala et al., 2013). These findings suggest that plastic, flexible cues like adiposity may be better indicators of immunocompetence than masculinity, a static cue that is invariable after puberty.

It is possible that men's facial attractiveness is more closely tied to plastic cues to current health, such as skin color and adiposity, than by a stable feature like masculinity. Facial masculinity may conceivably play a larger role in intrasexual competition between men, and that preferences for masculinity may be due to women desiring competitive men rather than apparent immunocompetence (Puts, 2010; Scott, Clark, Boothroyd, & Penton-Voak, 2012). However, although masculinity may be clearly associated with perceptions of dominance, its ties with

health made by Rhodes et al. (2003) and Thornhill and Gangestad (2006) cannot be ignored. It is possible that modern medicine affects the masculinity-health relationship in ways that were not possible throughout the majority of human history (Little, 2012). It is also important to remember that preferences for masculinity are strongest during times when women would prioritize genetic benefits in a partner (i.e., peak fertility, short-term relationships, circumstances of low paternal investment), suggesting that masculinity has some relationship with heritable genetic traits. Although the relative effects of masculinity on intrasexual competition and intersexual selection are not entirely clear, it is important to point out that the effects of a particular cue in one domain do not preclude its effects in another. Given the empirical evidence, it is likely that facial masculinity is both a cue to physical dominance and mate quality.

Whereas facial femininity has a clear correlation with perceived attractiveness in women's faces, the effects of facial masculinity in men's faces are less clear. Masculinity preferences are affected by social context and can change even within an individual. Despite a plethora of studies, the role of facial masculinity in attractiveness is not understood comprehensively. That means that, although facial masculinity is one of the most-studied aspects of attractiveness, there is still a great deal of research to be done, which should produce new and exciting findings to reconcile apparent disparities in the field.

Personality attributions from faces

The previous section described why certain facial characteristics may be attractive; for instance, face coloration is indicative of cardiovascular health and carotenoid level and facial adiposity relates to immune function. These features are representative of health and are, in at least some cases, reliable cues to mate quality. That leaves one to wonder: if facial cues can signify underlying health and mating condition, then can they also reflect cognitive and

emotional traits such as personality? In this section, we will examine the evidence that faces can signal particular personality and behavioral characteristics.

Physiognomy: A study gone by?

The idea that personality is detectable in the face is known as physiognomy, a notion that stems back to ancient times. Among the first prominent thinkers to contemplate the relationship between face structure and personality was Aristotle, who is credited with writing the Greek treatise *Physiognomica*. In this, assessments of personality were drawn from the similarities of one's body structure to that of an animal. For example, a lion has large extremities and is brave; therefore, a man with large extremities is also brave (Evans, 1969). The theories behind physiognomy developed through the Middle Ages and were later even taught at universities as a skill that only select practitioners could master. Physiognomists were later outlawed by King Henry VII of England as charlatans and criminals. Despite this, the practice continued, and in 1772 the Swiss pastor Johann Lavater published a series of influential articles titled "Essays on Physiognomy" in which he stated that imperfections in the face reflected imperfections as a person.

Modern Physiognomy

Although it is obvious that early concepts of physiognomy were misguided (for example, facial blemishes do not necessarily signal a terrible person, and looking like a certain type of animal is unlikely to indicate behavioral similarities; though see Zebrowitz et al., 2011), the idea of facial appearance reflecting personality traits has not vanished. Indeed, recent studies suggest that facial characteristics influence perceptions of personality and may, in fact, be reliable indicators of actual personality driven behavior.

Early scientific studies on physiognomy found very little (if any) evidence for a relationship between facial features and personality traits (Cleeton & Knight, 1924). Similar results were found throughout most of the 1900s (Alley, 1988). However, more recent studies have brought a different line of thought to physiognomy. Whereas early studies examined relationships between isolated facial features and personality (for example, eye size and impulsiveness; Cleeton & Knight, 1924), modern studies have examined how overall face shape and the configuration of features within a face relate to measures of behavior. This shift has a scientific basis: research in face processing has established that faces are processed largely "holistically," rather than in a feature-by-feature fashion (Tanaka & Farah, 1993). Given that faces are processed as a whole, it follows that perceived social characteristics are also dependent on whole face stimuli.

Since the theoretical shift towards studying social judgments as a product of whole faces (and not individual features), dozens of studies have reported reliable personality judgments of target faces across observers. Most of these studies have focused on perceptions of the "Big Five" personality traits – extraversion, agreeableness, conscientiousness, emotional stability/neuroticism, and openness to experience (Costa & McCrae, 1985; McCrae & Costa, 1987). A remarkable number of experiments have found that, when shown an image of a person's face, independent observers will make similar judgments of these traits (see Albright et al., 1997; Berry & Zebrowitz McArthur, 1985; Secord, Dukes, & Bevan, 1954; Zebrowitz McArthur & Apatow, 1984). That is to say that separate people agree (or show "consensus") about how a person may behave based solely on images of his or her face. Judgments of personality reach high consensus even among three-year-old children (Cogsdill, Todorov, Spelke, & Banaji, 2014).

That there is any consistency in judgments of personality of a target face may be surprising enough; but, perhaps more interesting, is that these judgments may accurately reflect real personality. Many studies have now shown that perceptions of personality drawn from single face images, short videotapes, or very brief personal encounters align with the target's self-reported personality (Ambady, Hallahan, & Rosenthal, 1995; Berry, 1990; Bond, Berry, & Omar, 1994; Borkenau & Liebler, 1992a, 1992b, 1993a, 1993b). Accurate personality judgments can even be made from computer-averaged faces. Penton-Voak, Pound, Little, and Perrett (2006) collected facial photographs of 294 people and asked them to complete a self-report of measures of the Big 5 personality traits. They found that observers made accurate judgments of extraversion (r = .24), emotional stability (r = .18) and openness (r = .22) for male faces, and extraversion (r = .25) for female faces. In a separate study, they averaged the faces of the 15 people (per sex) who rated themselves highest, and the 15 people who rated themselves lowest, for each personality trait (Figure 4). Penton-Voak et al. (2006) found that the composite made from the people who self-reported a high degree of a particular trait was rated higher for that trait than was the composite made from the people who self-reported a low degree of the same trait for each of agreeableness, extraversion, and emotional stability (though the last of these was only found for men's faces). This study indicates that personality can be perceived from digitally synthesized faces, and not just individual faces. Taken together, these results suggest that although the correlations are small, they are significant – that there is indeed some aspect of personality – or some "kernel of truth" – to judgments of personality made from faces.

Please insert Figure 4 about here

How do faces reflect personality?

Now that researchers have established that faces contain some element that reflects personality, one must question how this relationship manifests. How could an external part of a physical being be in accordance with what is, in essence, a product of the mind? Zebrowitz and Collins (1997) suggested four primary causes, and we will briefly cover them below. Since "personality" is a catch-all term for the cognitive, emotional, attitudinal, and behavioral characteristics that a person displays, it would be an enormous undertaking to cover every personality trait (and perhaps redundant, as many seemingly distinct personality traits are actually highly correlated; Penton-Voak et al., 2007; Zebrowitz & Collins 1997). Oosterhof and Todorov (2008) used computer modeling technology to isolate two main components of social judgments from faces – whether we should approach or avoid a person (trustworthiness, often based on emotional expression), and whether the person is capable of inflicting harm upon us (dominance). Given this, and for the purposes of brevity, we will restrict our analysis of the causation behind the personality/facial appearance relationship to one social judgment that has an enormous impact on human social perception and interaction: perceived dominance.

Facial cues to dominance. Physical dominance has had a great impact on human social interaction throughout history (Puts, 2010). 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 behavior (Bowles, 2009; Walker, 2001). 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 parabolically with the cross-sectional width of bone. Larger, more physically dominant primates are therefore able to inflict disproportionately more damage than smaller conspecifics. In humans, size and strength correlate with the frequency of

physical aggression and confrontation (Archer & Thanzami, 2007; Felson, 1996; Tremblay et al., 1998).

Given the role that aggression and physical confrontation have played in shaping human history, it would have benefited early humans to quickly and accurately process a potential rival's physical size and strength. Faces are especially salient in forming social judgments of others, perhaps more so than other body domains (Currie & Little, 2007; Mueser, Grau, Sussman, & Rosen 1984; Peters, Rhodes, & Simmons, 2007), thus it is conceivable that faces could convey accurate information about physical dominance. Consistent with this, many studies have demonstrated that dominance is a trait that can be perceived from human faces. Ratings of physical dominance have been found to correlate with handgrip strength (Fink et al., 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.

Consistent with its relationship to physical dominance, facial appearance can also be indicative of perceived and actual dominant behavior. Masculinizing human faces increases perceived dominance in male and female faces, whereas making a face more feminine decreases perceived dominance (Boothroyd et al., 2007; DeBruine et al., 2006; Jones et al., 2010; Main, Jones, DeBruine, & Little, 2009; Perrett et al., 1998; Figure 3). People with masculine and dominant-looking faces are perceived as more aggressive and threatening (Oosterhof & Todorov, 2008), and men with facial characteristics associated with dominance are more likely to be perceived as untrustworthy (Stirrat & Perrett, 2010). Men with dominant-looking faces have

higher social status (Mueller & Mazur, 1996), and people are more likely to follow the gaze of dominant-looking individuals (Jones et al., 2010; Ohlsen, van Zoest, & van Vugt, 2013). Perceptions of dominance also drive the expectation of displays of anger and contempt (Hess, Adams, & Kleck, 2005) and men with dominant-looking faces act less cooperatively and less trustworthy in real life (Stirrat & Perrett, 2010). Dominance is such an important trait in humans that reliable perceptions of dominance can be made from faces with neutral expressions in as little as 39 ms (Carré, McCormick, & Mondloch, 2009) and even children as young as three-years-old make reliable judgments when asked to rate faces on a "strong/not strong" scale (a scale of dominance revised for children; Cogsdill et al., 2014).

Facial appearance and personality – four possible causal relationships

Common biological cause. The studies mentioned above suggest that perception of dominance and masculinity correlate with actual measures of forceful behavior. But how do dominant people get dominant-looking faces? The answer may lie in the underlying hormones responsible for both brain development and physical appearance. For example, testosterone is important in prenatal brain development (Chowenbreed, Steiner, & Clifton, 1989) and is responsible for masculinization in puberty (August, Kaplan, & Grumbach, 1972). Testosterone can manifest in personality traits through enhanced aggression – testosterone levels 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). Testosterone affects facial development as well: the 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 et al., 2011; Swaddle & Reierson, 2002) than are the faces of men with lower

testosterone levels. One study found that perceived facial masculinity and dominance correlated with an indicator of prenatal testosterone level (2D:4D finger ratio; Neave, Laing, Fink, & Manning, 2003; see also Frank & Shaw in Chapter XX of this volume). In addition, men with masculine facial structures exhibit greater surges in circulating testosterone in response to winning competitions than men with less masculine faces (Pound et al., 2009). These studies indicate that perceptions of masculinity and dominance are associated with actual measures of testosterone, a hormone associated with dominant behavior (Archer, 1991; Mattsson et al., 1980; Mazur & Booth, 1998). Using these examples, it is possible to conclude that the relationship between personality and facial appearance may be mediated by a common hormonal mechanism affecting both.

Common environmental cause. The biological basis for the appearance/personality relationship is compelling, but only one of several possible explanations for why appearance may reflect personality. Although internal physiology and endocrinology may alter personality and appearance, it is also possible that these characteristics are similarly affected by the external environment. That is, an individual's own circumstances may shape his or her behavior and physical development. Let's examine this possibility from the perspective of dominance. Testosterone spikes at puberty, which affects both facial appearance and personality. Studies have shown that an unstable environment during childhood—for instance, growing up in a dangerous neighborhood, parental conflict, or divorce—leads to early onset of puberty (Belsky, Steinberg, & Draper, 1991; Wierson, Long, & Forehand, 1993). The influx of testosterone would lead to masculine, dominant facial features at a younger age. At the same time, environmental instability may lead to the development of an aggressive, anxious, and confrontational personality. Thus, an individual's own circumstances could create concordant physical and

behavioral characteristics independent of biological underpinnings. Like the previous example of the influence of hormones, facial appearance and personality could develop separately, yet converge to show congruence across domains.

Facial appearance shapes personality. The biological and environmental explanations both illustrate how personality and appearance could develop simultaneously. It is also possible that there are direct causal relationships between the two. For example, facial appearance itself may influence personality. Using dominance as a model once again, it is conceivable that some people are born or develop faces that purvey the appearance of dominance by chance. The appearance may be initially unrelated to any actual personality disposition. If, however, other people react to a dominant-looking person in a fearful or submissive way, and this reaction is consistent throughout a person's life, it is possible that the person may learn to act aggressively and to force their will on others, thus developing a dominant personality over time (i.e., a self-fulfilling prophecy effect; Zebrowitz & Collins, 1997).

Personality shapes facial appearance. Just as appearance could dictate personality, the opposite could also occur. It is possible that a person's face could be molded by their mindset. Let's take our example of dominance once more. If a person has a dominant disposition and regularly acts with aggression and initiates confrontation, he or she would be prone to frequent facial expressions of anger. One characteristic of a face that drives perceptions of dominance is the furrowing of the brow, or lowering the eyebrows closer to the eyes (Keating, 1985; Keating et al., 1981; Zebrowitz & Lee, 1999). Frequent jaw clenching among individuals with dominant personalities could enhance the mandible muscles, increasing the appearance of a "strong jaw" and potentially expediting the early development of apparent frown lines. In a man, a dominant mind-set may instigate the growth of a beard, a feature of appearance that increases perceived

dominance (Neave & Shields, 2008). Furthermore, aggressive behavior may lead an individual into physical confrontation, which may leave visible scars which could also give the impression of dominance. Thus, a person may have an inherently dominant personality and subsequently develop a dominant appearance. Similar relationships could be formed with other personalities as well (imagine a happy and approachable person smiling to the point of developing laugh lines, etc.). These examples illustrate how one's frame of mind could alter his or her external appearance (i.e., a Dorian Gray effect; Zebrowitz & Collins, 1997).

In all likelihood, it is not one of these theories, but a combination of all, that accounts for the relationship between facial appearance and personality. Biological underpinnings could account for similarities between internal and external characteristics, but it is just as possible that environmental causes shape both. Likewise, facial cues may encourage personality through the actions of third parties, and an individual's natural disposition could account for variation in facial appearance. It is conceivable, and indeed likely, that appearance and personality interact in a feedback loop – the way one looks could affect the way one is treated, which in turn affects the chemical processes associated with behavior, which itself could influence the way one looks. Although early concepts of physiognomy were rife with unjustified theories and claims, we can conclude that more recent studies show that the relationship between facial appearance and personality is not pseudoscience. Indeed, the documented association between personality and appearance indicates that maybe the physiognomists had the right idea the whole time, but that their theories just needed a bit of guidance.

Who can read faces, and what faces can they read?

Many studies have shown consensus about personality judgments across participants, however it seems that some people are better at it than others. Ambady et al. (1995) found that

people who receive high scores on the PONS scale (Profile of Nonverbal Sensitivity, a measure of one's ability to recognize the communication of feelings and attitudes; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979) were more likely to accurately perceive extraversion and positive affect in target faces (as measured by self-report scales) than people with lower scores. Interestingly, however, people with high sociability scores were relatively less accurate at judging personality from faces. Conversely, people show an enhanced ability to accurately perceive the personality traits of sociable people than less sociable people from faces alone. Other studies have found that people who are more confident, sociable, and have higher self-esteem are perceived more accurately than are shy and introverted people (Borkenau & Liebler, 1992b). Ambady et al. (1995) qualified these findings by noting that such faces are only more accurately perceived for some characteristics, such as extraversion and agreeableness, not necessarily all personality traits. Penton-Voak et al. (2006) also found that certain traits were easier to read in male faces than female faces, whereas others have noted that women are better at reading personality from faces than men (Ambady et al., 1995).

Recent studies have found that the perception of facial dominance is affected by individual differences as well. As dominance may inform which individuals to approach and which to avoid (Oosterhof & Todorov, 2008), it is perhaps unsurprising that people of large physical stature are less sensitive to facial cues of dominance than others. For example, tall men and women are less likely to perceive changes in dominance associated with the masculinization of faces and voices than are shorter men and women (Watkins, Jones, & DeBruine, 2010; Watkins, Quist, Smith, Debruine, & Jones, 2012). Likewise, men who score higher on the dominance subscale of the international personality items pool (Goldberg, 1999) are less likely to perceive masculinized men's faces as more dominant (Watkins et al., 2010). Similar results have

been shown for women with high dominance scores viewing masculinized women's faces (Watkins et al., 2012). These studies suggest that, just as some people are better at reading positive personality traits from faces, others are more sensitive to cues of dominance.

Caveat: Be wary of overgeneralization

This section has focused on accurate judgments of personality that can be made from facial appearance alone. It would be imprudent, however, to suggest that faces give away all of a person's personality. In fact, it is far from the truth. The studies mentioned above have found reliable relationships between appearance and personality; however, these findings usually represent a "kernel of truth" – that is, there is some predictive validity of appearance to personality, but only some. Indeed, reported correlations between personality judgments are usually minor to moderate (with the most striking correlation coefficients reaching 0.2 to 0.4, and most falling below this range; Zebrowitz & Collins, 1997).

Facial appearance can convey an element of an individual's personality, but these cues can lead to overgeneralization, often with deleterious implications. For example, attractive people may enjoy the benefits of a "halo effect" in which their beauty increases the likelihood of being perceived in a positive way (Dion et al., 1972), including sociability, intelligence, and warmth. Although it is possible that attractive people may be slightly more sociable than average (likely due to the confidence invoked by being attractive), the halo effect is essentially an overgeneralization of positive attributes. Likewise, natural resting faces may resemble emotional expressions simply by chance, which can lead to overgeneralization of emotional states; for example, male faces in a neutral state look angrier than female faces (Adams, Nelson, Soto, Hess, & Kleck, 2012; Zebrowitz, Kikuchi, & Fellous, 2010) and Caucasian faces resemble expressions of anger more than Black or Korean faces (Zebrowitz, Kikuchi, & Fellous, 2010). In

turn, this overgeneralization can, and indeed does, have unintended consequences in society. For instance, attractive students are perceived as more intelligent and are judged to have higher potential by teachers (Ritts et al., 1992), and attractive people face less stringent prison sentences than unattractive people who commit the same crimes (Stewart, 1980). Similarly, resemblance to emotional expressions in the resting faces of Black or Korean targets contribute to racial stereotypes among Caucasian perceivers in the US (Zebrowitz, Kikuchi, & Fellous, 2010).

As mentioned above, King Henry VII outlawed physiognomy during his reign, believing the study to be the practice of charlatans. It is true that the notions of physiognomy understood in King Henry's time were incorrect, and scientific studies in the early 20th century failed to find relationships between individual facial features and personality traits. Despite this, more contemporary research suggests that face judgments of personality can reflect, at least in small part, aspects of an individual's personality. Although it is important not to overgeneralize these judgments, it does seem that people can decipher some elements of behavior from appearance. Faces of people with particular personalities are easier to read, and some people are better at reading faces than others, but one thing is clear – there is some accuracy in judgments of personality from faces after all. Aristotle would be proud.

Dynamic facial cues

Most of this chapter has focused on research involving stationary images of faces. These studies usually present a face with a neutral expression and ask observers to rate the stimuli for some social judgment, such as attractiveness or dominance. It is important to note, however, that faces are viewed in dynamic motion in day-to-day life. This raises the question of how much ecological validity studies using static images of neutral faces actually have. Are there differences between ratings of stationary images and the perception of faces in the real world?

How do dynamic and malleable facial cues affect social judgments beyond what can be captured in a still photograph? This section will examine how dynamic and expressive facial cues affect social perception, and will compare studies across dynamic and static stimuli.

Face perception using static vs. dynamic stimuli

It is obvious that perceptual differences may arise between static images of faces and video clips showing dynamic movement, including head motion or facial expression, of the same face. Static images capture a face at one point in time and from a particular perspective (usually straight-on in face research studies). Such images cannot show an entire face, nor can they capture the range of emotional expression of which a face is capable. In theory, video clips could present everything that a static photograph can – they retain all the useful qualities of a still photograph but also allow observers to view a face in its natural dynamic state, capturing expressive reactions to interactions with others. Indeed, people are better at recognizing faces of famous people from dynamic video sequences than from individual still frames, even if there are enough frames to present the face from the same perspectives as the video (Lander, Christie, & Bruce, 1999), suggesting that the fluid whole is greater than the sum of its static parts.

Face recognition may be easier from dynamic face stimuli than still images, but does perception of facial cues vary between the two? A handful of studies have attempted to examine whether social judgments of static two-dimensional facial photographs correlate with those from videotapes of the same faces. Rubenstein (2005) took 10-s video clips of 48 women's faces while they read a passage with a neutral expression. Male observers rated attractiveness for both the video and still frames extracted from the clip. Attractiveness ratings for the dynamic and static image groups were very similar when averaged across faces, indicating that one stimulus type was not inherently more attractive than the other. Surprisingly, however, attractiveness ratings of

clips and videos of the same face were not correlated (r = .19, p = .26). That is, faces that were found attractive in videos were not necessarily found attractive in still images. Furthermore, although observers rated the images as emotionally neutral, emotion ratings of the video clips showed high variation, and this variation correlated with attractiveness ratings. Thus, attractiveness ratings of dynamic face stimuli may be affected by perceived emotion, which may not be reflected in still images. It is also possible that still images do not afford depth information the way that dynamic stimuli might, which could affect perceptions of attractiveness. Other studies have since failed to find correlations in attractiveness ratings between static and dynamic stimuli for male faces (Lander, 2008; Penton-Voak & Chang, 2008), though both of these studies found a relationship for female faces.

The aforementioned studies failed to find significant and generalizable correlations between perceptions of static and dynamic stimuli of faces. These studies could have been affected by methodological issues. Early studies used between-subjects designs, such that different participants would rate the static and dynamic versions of the same face. This method prevents any confounds present in rating the same face twice, yet it is possible that individual differences in face preferences could account for variance in perceived attractiveness. Roberts et al. (2009) conducted a comprehensive study to investigate whether there were discrepancies in attractiveness ratings between static and dynamic stimuli using both within- and between-subjects designs. They found strong and significant correlations for static and dynamic stimuli across all levels of target and observer sex (all r's ≥ 0.73). Nevertheless, correlations were stronger in the within-subjects condition (when observers rated both the static and dynamic stimuli of the same face) than in the between-subjects condition (when different subjects rated static and dynamic stimuli of the same face). The discrepancy between ratings of static and

dynamic stimuli was also greatest for women rating male faces. These findings may explain why previous studies found non-significant correlations between stimulus types using a between-subjects design with male faces.

More recent studies have manipulated faces in video clips, similar to techniques used in static images. One study manipulated faces within video clips and found that feminized female faces were more attractive than masculinized female faces, but no preference was found for feminized versus masculinized male faces (Morrison, Clark, Tiddeman, & Penton-Voak, 2010). These results replicated across faces acting in a social manner (the filmed participant was asked to respond to a question as though to encourage interaction with the asker) or antisocial manner (discouraging interaction). It is important to note, however, that still images extracted from the videos also failed to produce masculinity preferences in male faces. Further work used similar transforms to examine whether individual differences may account for masculinity preferences in video clips of male faces, finding that women's own attractiveness predicted preferences for men's facial masculinity (O'Connor et al., 2012). This replicates results from static stimuli demonstrating that attractive women prefer more masculine men (Penton-Voak et al., 2003), and may partly explain the lack of masculinity preferences found in previous studies where observers' attractiveness was not rated (Morrison et al., 2010). Other studies have found high agreement between static and dynamic stimuli in terms of attractiveness (Kościński, 2013; Rhodes et al., 2011), and have found that ratings of averageness, symmetry, and masculinity all correlate with attractiveness in video clips of men's faces, much as they do for static face images (Rhodes et al., 2011). Men with faces perceived as attractive in video clips also report more sexual partners, similar to findings in static stimuli (Rhodes, Simmons, & Peters, 2005). Taken

together, the results of studies using dynamic face stimuli suggest that social judgments made from static images correlate with those made from video clips.

Faces in 2D vs. 3D

The vast majority of face perception studies have used static, two-dimensional (2D) images. Recent advances in computing and imaging technology have allowed for the wide-scale use of high-quality three-dimensional (3D) stimuli in face research studies. These faces can be "rotated" on a screen from side to side to show a face from all angles (Figure 5). Three-dimensional face processing therefore allows for stimuli that are more ecologically valid. Some software programs allow for manipulations of 3D faces in much the same way as 2D faces. Thus, recent studies have used transforms in masculinity and facial adiposity in studies of 3D stimuli (Re et al., 2011).

Please insert Figure 5 about here

Studies using 3D faces have become more prevalent in recent years, allowing for comparisons to results found with 2D faces. In recent studies of face preferences, Coetzee et al. (2011) and Re et al. (2011) found that participants manipulated adiposity in women's faces to reflect BMI levels of 19-20 kg/m^2. These results align with similar findings in 2D faces (Re & Perrett, 2013) and BMI preferences for overall body physique (Tovee & Cornelissen, 2001; Tovee, Maisey, Emery, & Cornelissen, 1999; Tovee, Reinhardt, Emery, & Cornelissen, 1998). Such findings show some cross-validation of results between 3D faces and 2D faces and bodies.

Comparable findings using 2D and 3D stimuli are reassuring, but not conclusive. One study has now directly examined correlations in social perception using 2D and 3D stimuli of the same faces. Tigue et al. (2012) collected 2D and 3D images of 39 women. The faces were

presented to 31 men, with the 3D faces rotating 180° from side to side. They found a strong correlation between ratings of attractiveness for 2D and 3D versions of the same face (r = 0.71), indicating that 2D and 3D stimuli supply similar cues to attractiveness. Interestingly, however, the 3D stimuli were rated as significantly more attractive than the 2D stimuli, on average. Tigue et al. (2012) interpret this finding as an indication that the extra visual information available in 3D stimuli may increase the perception of attractiveness (though these results do not seem to replicate when comparing static images to video clips). Three-dimensional face stimuli may not only produce similar social judgments as 2D stimuli but may also enhance such perceptions, suggesting that 3D stimuli may increase ecological validity and thereby providing evidence to promote the use of 3D faces in future studies. Further studies could be done to assess how social judgments made from 3D stimuli relate to those made from video stimuli—the two forms of dynamic face presentation

New directions in contemporary physiognomy

Early concepts of physiognomy, or the study of personality judgements from faces, were somewhat misguided, yet more recent theories and methods find relationships between personality characteristics and facial appearance. The personality dimensions examined in most of these studies have been fairly basic. Traits like those discussed in previous sections, including the "Big Five" and dominance, can be measured as continuous variables and can be applied to any individual (Costa and McCrae, 1985; Watkins et al., 2010).

Face perception researchers have established reliable relationships between appearance and basic, continuous personality traits. But can appearance convey information about more complex aspects of personhood? Can facial cues inform perceivers of an individual's ability to achieve success? What about distinct social preferences? Given the existence of facial cues to

personality, it is perhaps not too much of an extension to think that appearance could relay information about personal preferences and dispositions. Indeed, recent empirical studies have started to uncover relationships between faces and facets of identity never before theorized.

Detecting success from faces

The *Physiognomica* discussed how human personality could be revealed by features shared with particular animals. Humans with facial characteristics resembling those of a lion, for example, were thought to be strong and courageous, capable of dominating rivals (Evans, 1969). Personality may not actually correlate with animalistic features (though it is still possible that resembling a particular animal may affect perceptions of personality; Zebrowitz et al., 2011), but recent studies suggest that faces may reveal an individual's ability to succeed. Several studies over the past five years have examined correlations between attributions of faces and objective measures of workplace success. Much of this work has focused on the faces of business leaders, as their success can be objectively measured through their companies' financial performance. Interestingly, several studies have demonstrated that business leaders' success is correlated with perceptions of dominance and power drawn from images of their faces (Rule & Ambady, 2008a; 2009). Other studies have found similar relationships between perceived power and success among the faces of Managing Partners of law firms (Rule & Ambady, 2011), indicating that facial correlates of success extend across different types of businesses. Further studies have found that facial dimensions associated with dominance and aggression (facial width-to-height ratio; Carré & McCormick, 2009) also correlate with success in business leaders' faces (Wong, Ormiston, & Haselhuhn, 2011). Similarly, although measures of leadership success are less defined in politics than they are in business, several studies have demonstrated that judgments of dominance and competence from political candidates' faces correlate with electoral success (see

Olivola & Todorov, 2010, for review). Conversely, facial characteristics that make a person appear youthful and friendly (sometimes referred to as "babyfacedness") also make one appear weak and incompetent (Zebrowitz McArthur & Apatow, 1984). In turn, babyfacedness reduces the likelihood of attaining leadership positions in politics (Zebrowitz & Montepare, 2005) and such features are not beneficial to leaders in the business world (Rule & Ambady, 2008), though these patterns may be moderated by race (Livingston & Pearce, 2009) and culture (Rule et al., 2010). Thus, whereas animalistic features may not correspond with matching personality attributes, judgments of power and babyfacedness do predict success in terms of business and political leadership.

Judging sexual orientation from faces

One study in the field of nonverbal behavior discovered that both heterosexual and homosexual participants could make judgments of sexual orientation at higher-than-chance accuracy when presented with short, silent video clips of individuals (Ambady et al., 1999). Recent studies have found that sexual orientation can be judged more accurately than chance using still photographs of faces, as well. Rule and Ambady (2008b) reported that men and women were able to categorize sexual orientation significantly better than chance guessing when exposed to male faces for 50 ms or longer. Interestingly, the accuracy of categorization was the same at 50 ms as it was when participants were able to view faces for an unrestrained amount of time, suggesting that perception of sexual orientation is registered relatively rapidly and efficiently. Sexual orientation can also be determined from women's faces (Rule, Ambady, & Hallett, 2009), even when cropped tightly to only show the eyes. Although perceptions of sexual orientation are accurate at above-chance levels at nearly unconscious presentation times (40 ms), accuracy is attenuated when participants are instructed to think carefully and deliberate about

their judgments, providing more evidence that the categorization of sexual orientation is processed automatically (see also Rule, Macrae, & Ambady, 2009).

Further research has focused on social factors that affect the perception of sexual orientation. One study found that American, Spanish and Japanese participants were able to accurately categorize sexual orientation from male faces from all three countries, demonstrating consistency across cultures (Rule, Ishii, Ambady, Rosen, & Hallett, 2011). American perceivers were better at judging sexual orientation than were Spanish and Japanese perceivers. Furthermore, Japanese participants were more likely to categorize someone as straight but Spanish perceivers were equally likely to rate a straight man as gay and a gay man as straight, possibly reflecting the disparate levels of tolerance for homosexuality in those countries. Further research has demonstrated that accuracy in judgments of sexual orientation is consistent across Asian, Black, and Caucasian perceivers and faces as well (Rule, 2011), and that straight individuals who have more experience interacting with gay men are better at categorizing male sexual orientation (Brambilla, Riva, & Rule, 2013), suggesting that differences in categorization are based on cultural standards and experience, rather than ethnicity.

One further study found that women's interest in mating alters the accuracy of judgments of sexual orientation from men's faces (Rule, Rosen, Slepian, & Ambady, 2011). Women's sensitivity to male sexual orientation varies by menstrual cycle phase, in that accuracy increases closer to peak ovulation. Women's sensitivity to sexual orientation in other women's faces does not vary across the cycle, however. Women also are better at categorizing male sexual orientation when primed to think about romance and mate choice, regardless of menstrual cycle phase. These results suggest that automatic processing of sexual orientation may function to

efficiently select members of one's gender of interest that may be eligible for further romantic interaction.

The aforementioned studies indicate that sexual orientation can be judged with above-chance accuracy for both men and women. Recent studies have begun to examine the physical characteristics responsible for categorization of sexual orientation from the face. Inverting sexually-dimorphic face cues in a face of a particular sex (i.e., masculinizing a female face or feminizing a male face in either shape or texture) increases the likelihood of categorizing that face as homosexual (Freeman, Johnson, Ambady, & Rule, 2010). One quantitative analysis of physical features found that faces of homosexuals were less symmetrical than faces of heterosexuals, and that perceptions of sexual preference varied by face symmetry (Hughes & Bremme, 2011). It is important to note that, though variables extraneous to the face, such as hairstyle, influence accuracy of judgments of sexual orientation, accurate judgments can be made when faces are presented without hair and clothing cues, and even when only isolated facial features such as eyes or mouths are displayed (Rule, Ambady, Adams, & Macrae, 2008).

Accuracy in judging social group membership from faces

At first glance, it may be surprising that workplace success and sexual orientation can be correctly categorized by facial cues alone. However, leadership success correlates with judgments of dominance from faces (Rule & Ambady, 2008b), which relates to actual measures of dominant behavior (Watkins, 2011). Furthermore, some research suggests that sexual orientation may be influenced by prenatal hormone exposure (Lippa, 2003; Meyer-Bahlburg et al., 1995), which has also been hypothesized to affect facial development (Neave et al., 2003). It would seem, however, that a direct hormonal relationship between physiology and personality is not required to purvey accurate social judgments from faces. For example, studies have found

that people can discern political party affiliation with above-chance accuracy (Rule & Ambady, 2010). Using facial stimuli of American politicians (cropped tightly around the outer edge of the hair), Rule and Ambady (2010) found that faces of Republicans were viewed as more "powerful" (a variable formed from ratings of dominance and maturity), and that this impression of power was found to mediate the relationship between perceived and actual party affiliation. These results extended to college students who professed allegiance to either the Democrat or Republican student organizations at their university. Further research found that political attitudes could be judged cross-culturally, with German and Swiss perceivers correctly judging left- or right-wing affiliation from the faces of Swiss and German participants, respectively (Samochowiec, Wanke, & Fiedler, 2010). Ratings of dominance again predicted both perceptual and actual political affiliation, with more dominant-looking people tending to have right-wing affiliation (Samochowiec et al., 2010).

Political affiliation is not the only ideological group membership that can be perceived from facial appearance. The mid-20th-century saw a preponderance of research on whether people could be accurately classified as Jewish from appearance alone. Jewish people suffered extreme prejudice and discrimination during the Second World War, and folk belief suggested that Jews could be distinguished from non-Jews by physical appearance (though in actuality, Nazis had training films on how to identify Jews based on stereotypes, and Jewish people were forced to wear clothing indicative of their culture in Nazi Germany; Allport, 1954). A string of empirical studies investigated whether Jews could, in fact, be distinguished from appearance (Allport & Kramer, 1946; Elliott & Wittenberg, 1955; Lindzey & Rogolsky, 1950; Pulos & Spilka, 1961). Two recent meta-analytic reviews of this research found that people were able to accurately categorize Jews and non-Jews from still facial photographs alone (Andrzejewski,

Hall, & Salib, 2009; Rice & Mullen, 2003), and one study found that similar effects were prevalent in modern times (Andrzejewski et al., 2009). The link between socio-cultural group membership and facial appearance was also found for members of the Church of Jesus Christ of Latter-Day Saints (commonly known as Mormons). Some Mormons believe they can distinguish people of their own faith from others. Interestingly, studies revealed that both Mormon and non-Mormon perceivers could correctly categorize faces of Mormons and non-Mormons with above-chance accuracy (Rule, Garrett, & Ambady, 2010a). Further studies showed that this distinction may be due to perceptions of health, with Mormons having healthier-looking skin color and texture (Rule, Garrett, & Ambady, 2010b). The latter finding is particularly interesting, as Mormons are actually healthier than non-Mormons in the United States (Enstrom & Breslow, 2008), again suggesting that accuracy in contemporary physiognomy may stem from real relationships between physiology and personal lifestyle.

The studies discussed in this section all point to the same surprising finding: aspects of workplace ability and personal lifestyle with no clearly-definable physical characteristics can be discerned from facial appearance with above-chance accuracy. It should be pointed out that "above-chance" does not necessarily implicate large effect sizes. For example, categorizing sexual orientation with 55% accuracy could still be significantly above-chance, but does not represent comprehensive and near-universal accuracy, as is found in perception of more obvious categories such as race (correctly categorized for >99% of faces; Remedios, Chasteen, Rule, & Plaks, 2011). A recent meta-analysis reviewed the literature on categorization of sexual orientation, political affiliation, and religious group membership (i.e., Jewish and Mormon targets and controls). The mean effect size for 92 studies using still photographs of faces was statistically significant (r = 0.26, 95% CI = [.21 - .32]; Tskhay & Rule, 2013). A file-drawer

analysis (Rosenthal, 1979) showed that an estimated 20,000 studies with an averaged null effect would be needed to make the current literature barely significant (p = .05). Furthermore, symmetry analysis of a funnel graph found no evidence of publication bias (Tskhay & Rule, 2013). Thus, it is clear that the perception of ambiguous group membership is a robust and replicable effect, with evidence of accuracy in categorizing sexual, political, and religious preferences.

Studies done on the perception of leadership success and ambiguous group membership have produced startling results, indicating that propensity for success and personal preferences may be imparted through facial traits. Clearly, it would be imprudent to suggest that one could discern an individuals' ability to succeed or their personal and social disposition with 100% accuracy, or that a significant level of accuracy would apply to all groups, preferences, or domains. Despite this, the average effect size in the meta-analysis of accuracy in categorizing perceptually ambiguous groups was significantly larger (r = 0.26) than recent estimates of the average effect size of studies across social and personality psychology in general (r = .21; Richard, Bond, & Stokes-Zoota, 2003). The studies on perception of ambiguous group membership discussed here may give rise to a new line of face research examining how social characteristics previously thought unrelated to facial appearance might be reflected in the face. Such "kernel of truth" studies have great implications in all aspects of human social life, and provide a new avenue for research in contemporary physiognomy.

Conclusion

The face is an exceptional source of nonverbal information. The research discussed here demonstrates how facial appearance provides insight into a myriad of personal characteristics, from health status and mate quality to personality traits. Advancements in technology have

allowed face researchers to render faces in three-dimensions to enhance the ecological validity of their studies, while simultaneously establishing the legitimacy of the two-dimensional face images used in traditional studies. New research suggests that faces offer information on personal traits previously considered to be unrelated to external appearance. There are currently hundreds of scientists dedicated to revealing the many ways in which faces affect human social interaction. However, despite the great many discoveries already made, new and exciting contributions to the face research literature continue unabated. The last section of this chapter described experiments that have discovered completely unique relationships in face perception research, most of which have been conducted in the past five years. To this end, do not be surprised if the contents of this chapter need to be updated to include many new and exciting findings in the years to come.

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Figure 1. Example of an averaged face (right) created by aggregating four individual female faces (left). Averaged faces tend to be more attractive than their constituent faces, but averaged faces are not necessarily the most attractive that a face can be.

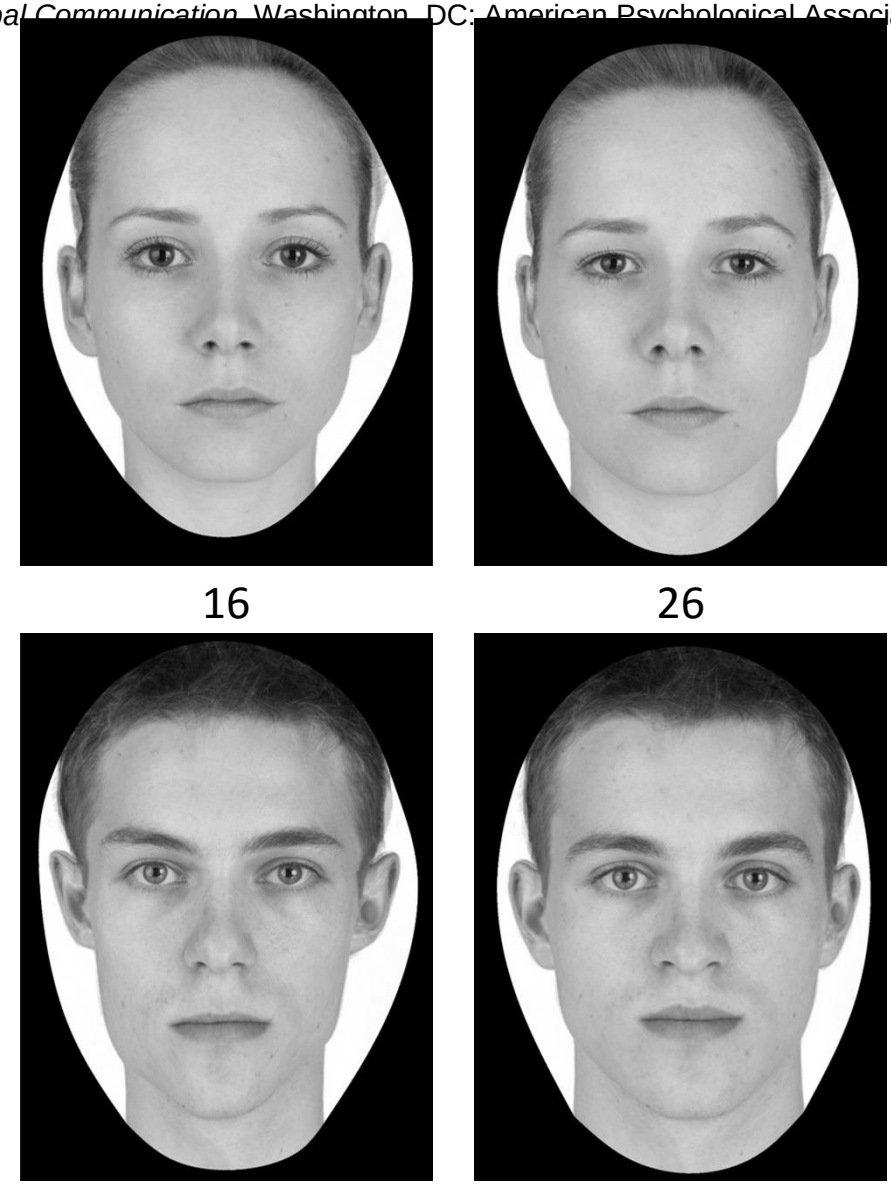

Figure 2. Female (upper panels) and male (lower panels) faces transformed in facial adiposity to represent a body mass index (BMI) of 16 kg/m^2 (left panels) and 26 kg/m^2 (right panels). Facial adiposity has a strong influence on attractiveness and correlates with measures of immunocompetence.

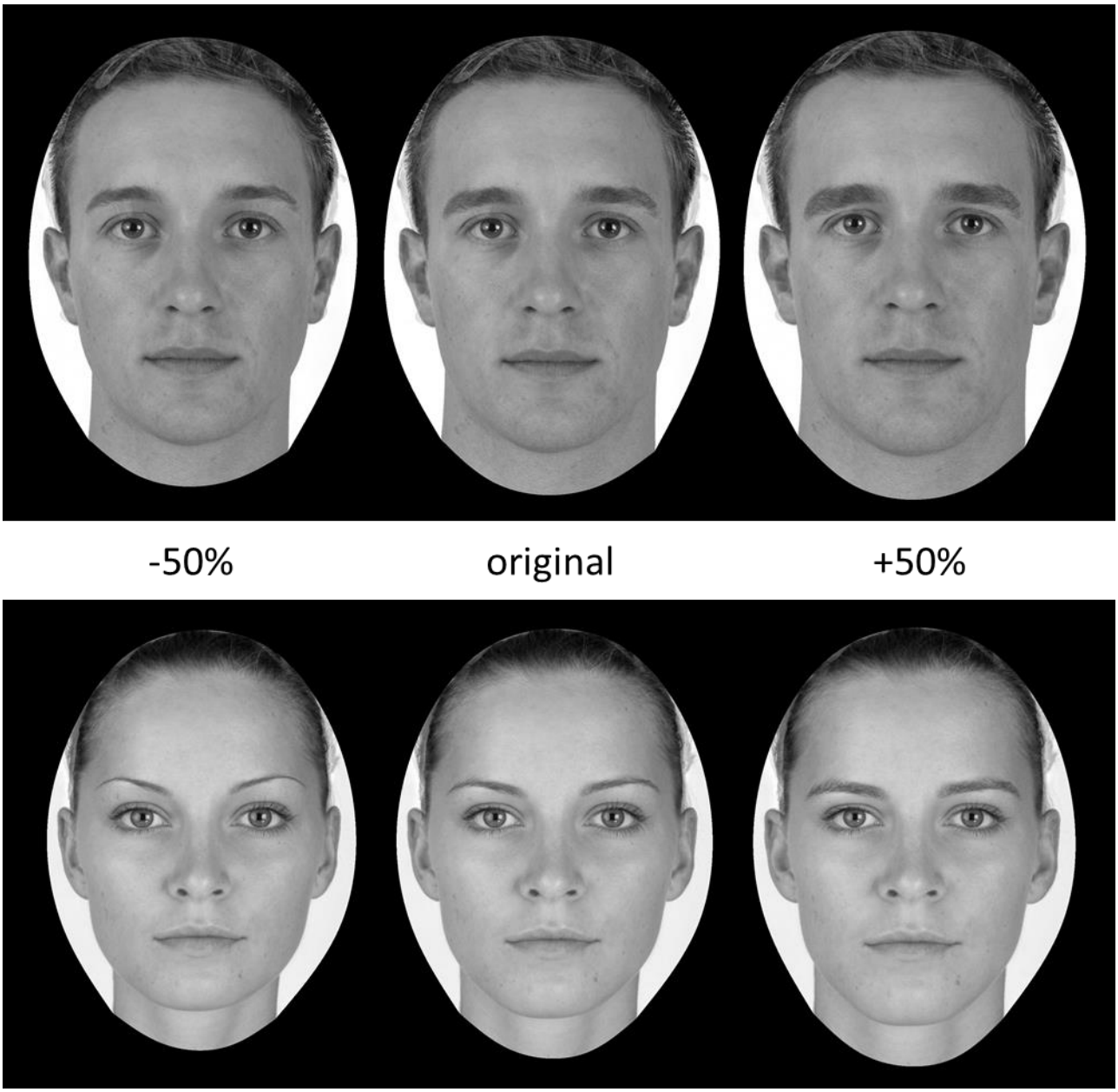

Figure 3. Example of a masculinity transform of a male (upper row) and female (lower row) face, including the original face (center column), and the same face manipulated 50% towards an average female face shape (-50%; left column) and 50% towards an average male face shape (+50%; right column). Facial masculinity has been found to influence attractiveness and perceived dominance.

Figure 4. Composites averaged from faces of men (top two rows) and women (bottom two rows) rated high (rows 1 and 3) and low (rows 2 and 4) for each of the "Big Five" personality traits (agreeableness, conscientiousness, extraversion, emotional stability, and openness, respectively from left to right). Studies indicate that personality can be reliably estimated from faces. Figure adapted from Penton-Voak et al. (2006).

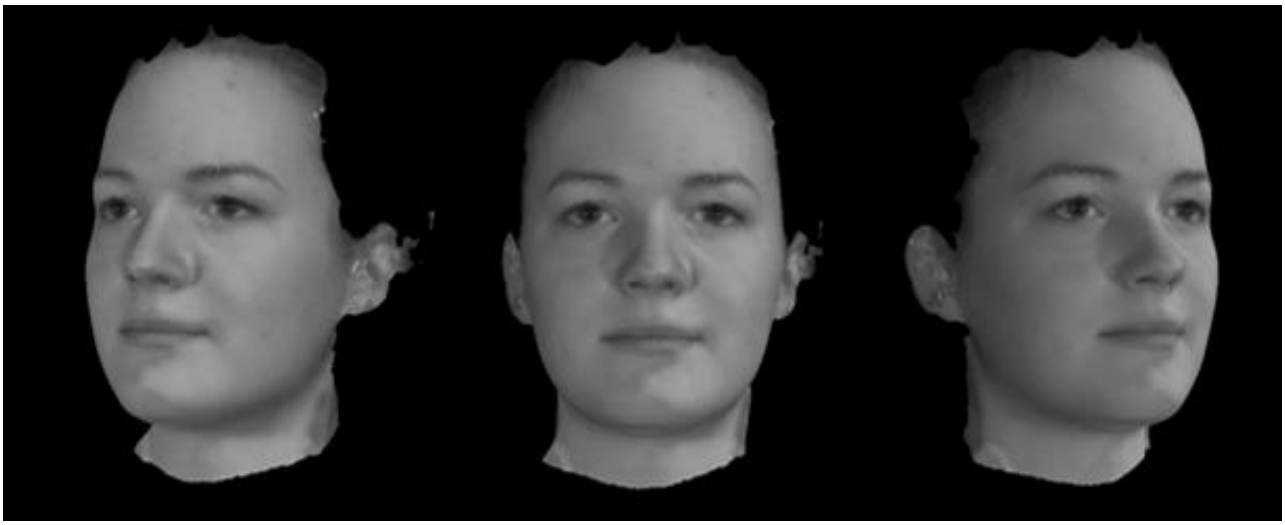

Figure 5. Three-dimensional (3D) scanned images of a female face, shown from center-view and left and right half profiles (three-quarter views). Three-dimensional stimuli are advantageous in face perception studies, as they present faces from various angles and perspectives.