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The effect of static cues and cosmetics on social judgements

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The Effect of Static Facial Cues and Cosmetics on Social Judgements

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I would like to dedicate this thesis to my grandfather, who showed me the natural world is more interesting than I could possibly imagine, and that learning is the greatest gift one can give. In loving memory.

Contents

Thesis Summary

The human face is one of the most significant stimuli we encounter, and carries a wealth of information regarding socially relevant traits. Previous research has begun to demonstrate that the face displays an array of cues or signals to social traits that others are able to detect. Moreover, the use of cosmetics by females can alter perceptions of social traits.

In the current thesis, I demonstrate that both facial shape, skin texture, and viewing angle contribute to the accurate detection of personality traits and physical health from the static, neutral face. The right side of the face affords greater accuracy for personality traits than the left, while facial shape and texture contribute differently to different traits. Consistent with previous literature, we find that skin texture is all that is necessary to accurately perceive health, and that this information is available from anywhere in the face.

I further investigate the accurate detection of personality in female faces, and whether the every day practice of cosmetics application has any effect on this accuracy. Results indicate that cosmetics do not affect perceptions of actual personality traits, but that perceptions are shifted towards the ideal personality of the wearer.

Cosmetics have greater effects on perceptions of social traits, rather than accurate detection. I examined sex differences in perceptions of various social traits in faces of females with and without cosmetics, finding that males generally think females appear more socially desirable without cosmetics, while female observers demonstrate an opposite pattern. Expanding upon this, I also illustrate than females wear an excess of cosmetics for optimal perceptions of traits related to attractiveness. Furthermore, I show that perceptions of attractiveness with cosmetics are generally lower for males across all ages.

Popular and conventional accounts suggest that cosmetics are used to attract mates, but the evidence presented here suggests they are failing. I provide the first evidence that the use of cosmetics may be miscalibrated towards a false ideal - females may be applying cosmetics for mistaken ideas regarding male preferences, when in fact, males prefer significantly lower amounts of cosmetics than a normal application results in. Surprisingly, we show that this mistaken belief also extends to males themselves, who feel other males are different to themselves.

Typical cosmetics application enhances sex differences in facial contrasts. I further investigated sex differences in skin colouration across multiple samples, and demonstrate how an application of cosmetics acts upon these differences, as well as adding desirable colour properties to faces. Overall, the current thesis further expands the body of literature demonstrating that facial skin plays a role in social cognition, and demonstrates the various ways that cosmetics act upon this feature to alter such perceptions.

CHAPTER 1: Introduction

"Everything is in the face."

- Cicero

The human face is arguably one of the most important kinds of stimuli in our environment. Evolution has shaped our brains to be extremely sensitive to faces - within the first moments of life, they capture our attention more than any other stimuli (Goren, Sarty, & Wu, 1975). We are also able to detect faces rapidly in naturalistic scenes (Fletcher-Watson, Findlay, Leekam, & Benson, 2008) and are prone to seeing faces in random patterns that share only remotely similar forms (Hadijkhani, Kveraga, Naik, & Ahlfors, 2009).

It is no surprise that faces drive many aspects of our social cognition. We make judgements about the character of an individual and their likely behaviours based on their face alone (Zebrowitz & Collins, 1997), something we have been doing for the majority of human history (Walker, 1834). These judgements influence our decisions on who to interact with on many levels, but are conventionally deemed baseless and unfair, using the phrase "don't judge a book by its cover" to describe the unsubstantiated nature of drawing conclusions from looks alone. However, a growing literature has demonstrated our judgements of others may not be unjustified. Instead, they have a surprising degree of accuracy, and are likely a vital part of our everyday social interactions.

1.1 What's in a face?

Consider stepping off a train into a city you have never visited before. Who do you turn to for directions? Statistically, any individual is as good a bet as another. However, in this situation, we are much more likely to approach people who look friendly and trustworthy. Research has demonstrated that from the face alone we are able to discriminate trustworthy individuals from untrustworthy ones (Stirrat & Perrett, 2010), the health and cardiovascular fitness of an individual (Stephen, Coetzee, Law-Smith, & Perrett, 2009; Stephen, Law-Smith, Stirrat, & Perrett, 2009), as well as an individual's proclivity towards short term sexual encounters (Boothroyd, Jones, Burt, DeBruine, & Perrett, 2008). In the same way we identify individuals as friendly and approachable, we are also able to detect how dominant (Mueller & Mazur, 1997) or aggressive (Carré, McCormick, & Mondloch, 2009) someone is likely to be. More surprisingly, observers have been shown to correctly infer the success of industrial companies from the faces of their chief executive officer (Rule & Ambady, 2009), as well as being able to correctly categorise others on their political stance from their appearance (Rule & Ambady, 2010). Moreover, these perceptions extend beyond simple day to day interactions and judgements. Individuals find faces that appear to possess certain traits more attractive, if they themselves desire that trait in a partner (Little, Burt, & Perrett, 2006). This suggests that these character judgements play a role in mate choice, which is arguably one of the most important decisions an individual will make in their lifetime. Perhaps what is most surprising about the aforementioned findings is that they occur simply from a static, neutral face. Dynamic information (Mazur, 2005) like clothing and posture, as well as facial expressions, have been shown to affect perceptions of others (Naumann, Vazire, Rentfrow, & Gosling, 2009). However, I refer here to only a neutral face - something we have almost no control over.

What are observers really picking up on in the face of others? It is highly unlikely that evolution has selected for such specific traits as political stance to be easily detectable on the face (Rule & Ambady, 2010). If our faces reflect our underlying, stable behavioural biases, then a reasonable assumption is that our facial appearance reflects our personality. Our personality is partially genetically determined (Bouchard & Loehlin, 2001), as is our appearance - a biological link is therefore a plausible explanation. A typical approach in personality research is to reduce the large inter-individual variance in stable biases to as few explanatory factors as possible. To this end, five-factor, or “Big Five” models, have demonstrated stability across culture and language (Benet-Martinez & John, 1998), and show agreement across varying measures (Paunonen, 2003). Perhaps most importantly, the factors actually predict an individuals behaviour from self reports of personality (Paunonen & Ashton, 2001).

Concordantly, a number of studies have demonstrated accurate detection of different facets of Big Five traits from the face, supporting the notion that our faces reflect our personality, through a mixture of biology and environmental influences. Penton-Voak, Pound, Little, and Perrett (2006) demonstrated that the ratings observers gave female faces were correlated with their self reported level of Extraversion, and that observers also correctly identified Emotional Stability and Openness. Additionally, several studies have used composite faces to demonstrate accurate detection of personality traits in faces. By taking individuals high and low in a particular trait and averaging their faces, idiosyncrasies of individual faces are removed, and the remaining features are what the individuals share in common - features that may be related to the personality trait they share. Indeed, using composite images, observers can discriminate between faces created from individuals high or low on Agreeableness and Extraversion (Penton-Voak et al., 2006). These findings were replicated by Little and Perrett (2007), who demonstrated additional identification of Conscientiousness and Emotional Stability. More recently, Kramer and Ward (2010; 2011) found accuracy for four of the five traits, with Conscientiousness being the exception. Taken together, these studies suggest that people with similar personality profiles share similar facial appearances, from which naive observers can draw accurate conclusions. Where in the face are these sources of information? What features of faces influence our perceptions of others?

1.3 Cues and signals

If an aspect of an organisms appearance has some effect on an observer, it can be thought of as either a signal, or as a cue. In psychological literature, these terms are often used interchangeably (Scheib, Gangestad, & Thornhill, 1999; Thornhill & Gangestad, 1999), but ethological literature has operationalised the terms more carefully. Cues can be broadly defined as an aspect of the environment that can be utilised when deciding what to do (Hasson, 1994). In the earlier example of entering a foreign city and approaching a stranger for help, a friendly face could easily be considered a cue - we use the friendly face as a cue to the probable helpfulness of the stranger, and so we decide to approach them. A signal, however, is a cue that alters the behaviour of conspecifics, and has been selected for due to those effects. Moreover, a response from an observer has also evolved (Maynard-Smith & Harper, 2003). For example, a brightly coloured insect that warns predators not to eat it is signalling its unpleasant palette, and predators respond by avoiding the insect as a meal. However, this need not be an honest signal - consider the fact some insects mimic the appearance of dangerous conspecifics in order avoid being consumed when they are, in fact, harmless (Maynard-Smith & Harper, 2003).

Most examples are not as clearly defined. A cue could in theory be anywhere along the continuum from cue to signal (Wyatt, 2010), and it is difficult to operationalise an exact location. It is equally as difficult to classify the human face as a source of cues or signals. Some biological evidence points toward the face being a source of signals. Humans have evolved neural substrates dedicated to perceiving faces (Kanwisher, McDermott, & Chun, 1997), which suggest they are certainly *worth* attending to. We are even able to accurately detect dominance from the faces of our closest living relative, chimpanzees (Kramer, King & Ward, 2011), suggesting our role as signal receivers is evolutionarily old. There is also some evidence that suggests some facial properties are trade offs between sexual selection and competitive displays. Females find men with wider faces less attractive, but they appear more dominant, which confers different kinds of successes (Stirrat & Perrett, 2010), and is evidence of selection pressures acting on facial properties (Kramer, Jones, & Ward, 2012).

There is sufficient evidence to suggest the human face signals information about an individual, using the most exact definition. As already stated, it is difficult to define whether a facial property is strictly a signal or a cue. This thesis deals examines signals as well as cues, and I take the more standard psychological approach of using the terms relatively interchangeably. However, through this brief overview, I hope to convince the reader of the differences between the two, and the difficulty of establishing a strict difference, a difference that is not absolutely necessary for the research herein.

1.4 Possible sources of information in the face

What aspects of faces cause us to make the judgements we do? If faces are capable of signalling or cueing information, there has to be some feature, or combinations of features, that are linked with certain perceptions. There has been much investigation into these sources in the literature, and this thesis explores several aspects in more detail (Chapters 2 and 6). The human face can be divided into two distinct categories, shape, and texture. Facial shape is characterised by the underlying bone and adipose tissue (Kramer, Jones, & Ward, 2012), which is defined mainly by hormonal and genetic influences (Verdonck, Gaethofs, Carels, & de Zegher, 1999). Skin texture is more adaptable and changes over the lifespan (Porcheron, Mauger, & Russell, 2013), and can be divided further by two key properties: the textural surface topography, and the colour distribution of the skin (Fink, Grammer, & Matts, 2006). I discuss each in greater detail below.

Shape and morphology. Sexual dimorphism is an important facial characteristic that is associated with attractiveness (Rhodes, 2006). Essentially, the degree to which ones face is more typical of ones sex is indicative of the ratio of sex hormones the individual experiences at puberty. Females experience greater levels of oestrogen which inhibits the growth of the jaw and brow ridge, and increases the size of the lips (Stephen & McKeegan, 2010). Males, conversely, experience greater levels of testosterone that increases the prominence of the brows, jaw and cheekbones (Rhodes, 2006). Femininity is strongly related to attractiveness in females (Johnston & Franklin, 1993; Perret et al., 1999), and is processed almost identically (O'Toole, Deffenbacher, Valentin, McKee, Huff, & Abdi, 1998). Interestingly, femininity is associated with neoteny - the ideally attractive female face shape shares many properties with that of a child's typical face shape, including fuller lips, a larger forehead, a small chin, and larger eyes (Johnston & Franklin, 1993). The general research consensus is that such features are considered attractive due to the premium of youthfulness in female mate value (Buss & Schmitt, 1993; Samson, Fink, & Matts, 2010). Younger females are more fertile in general, and fertility is essential for reproduction (Furnham & Reeves, 2006). These ‘babyface’ qualities are also associated with perceptions of trustworthiness and friendliness (Oosterhof & Todorov, 2008) as well as warmth, honesty, and kindness (Berry & Zebrowitz-McArthur, 1985; 1986). On average, female faces conform more to this shape than do males. It is no surprise, then, that females generally are more friendly and warm than males (Costa, Terracciano, & McCrae, 2001; Feingold, 1994). Using neoteny as a cue to social behaviours is likely to result in a degree of accuracy.

The typical male face develops under the influence of testosterone, producing a wider jaw, more pronounced eyebrows and higher cheekbones (Rhodes, 2006). Unlike females, increased sex typicality in males is not associated with attractiveness (Scott, Pound, Stephen, Clark & Penton-Voak, 2010). However, a more masculine appearance is associated with aggressiveness (Carré, McCormick, & Mondloch, 2009), dominance (Mueller & Mazur, 1997; Swaddle & Reierson, 2002), and dishonesty and coldness (Perrett et al., 1998), though causal links with testosterone are tenuous (Archer, 2006). In contrast to females, males tend to be more assertive, dominant, and less nurturing and warm (Costa, Terracciano, & McCrae, 2001; Feingold, 1994). A masculine facial appearance is, like a feminine appearance, linked to general social traits. Concordantly, females with more masculine faces tend to possess similar traits to males, such as dominance (Quist, Watkins, Smith, DeBruine, & Jones, 2011). These facial attributes are also related to life outcomes - babyfaced people are perceived as less competent (Poutvaara, Jordahl, & Berggren, 2009), though get away with lighter sentences in courts (Montepare & Zebrowitz, 1998). More dominant faces also lead to greater promotional success (Mueller & Mazur, 1997; Rule & Ambady, 2008).

Perhaps one of the most widely researched aspects of facial shape is symmetry. In non human animals, symmetry reflects phenotypic quality, indicating how well an individual can continue to develop normally despite the presence of environmental stressors (Møller & Thornhill, 1997). Grammer and Thornhill (1994) demonstrated that facial symmetry is positively associated with attractiveness, which suggests that symmetry also plays a role in human phenotypic quality (Perrett, Burt, Penton-Voak, Lee, Rowland, & Edwards, 1999). Fluctuating asymmetry (FA) is used to describe deviations from perfect symmetry, and these deviations are thought to represent losses in fitness (Thornhill & Møller, 1997). It is no surprise, then, that people perceive individuals with lower levels of FA as being healthier (Zaidel, Aarde, & Baig, 2005). Symmetry is certainly a signal of attractiveness and health, but other research has demonstrated its role in perceptions of other social traits. Noor and Evans (2003) demonstrated that individuals with greater levels of FA were perceived by others as being less emotionally stable, more impulsive and untidy, as well as less friendly. However, these perceptions are a distinct issue from accuracy - there was no measure of the models' personality by Noor and Evans (2003). However, Shackelford & Larsen (1997) demonstrated that both higher levels of FA is associated with individuals being less sociable, less optimistic, less active, and were more impulsive and more angry. Taken together, these findings suggest symmetry may be a cue to the likely behaviours of an individual. These examples demonstrate that our facial morphology is linked with our personality in surprising ways, and that these perceptions have real world outcomes.

Texture information. The texture of skin is an important signal of attractiveness and mate value. Morris (1967) claimed that flawlessly textured skin is one of the most desired of human features, especially for females. Indeed, Fink, Grammer and Thornhill (2001) demonstrated that males find homogeneously textured skin particularly attractive. In females, imbalances in androgens can cause issues with fertility (Steinberger, Rodriguez-Rigau, Smith, & Held, 1981), and can manifest as skin blemishes and dermatoses (Lucky, 1995). Skin texture is also a powerful cue to age. As we age, collagen in our skin degrades, leading to wrinkles and other pigmentations (Burt & Perrett, 1995). This leads to a variety of perceptions associated with age such as dominance and meanness (Berry & Zebrowitz McArthur, 1986). Due to the inverse relationship between skin condition and age, a smooth skin texture is important for female mate value, as fertility decreases with age (Pawlowski & Dunbar, 1999). Moreover, skin ages at a similar rate to the internal viscera, and therefore represents a view of overall systemic age (Farage, Miller, Elsner, & Maibach, 2008), which is correlated with health (Fink, Grammer & Matts, 2006). Skin texture has received little attention in psychological literature (Samson, Fink & Matts, 2010), and the present thesis goes some way to addressing this.

Colour information. The colouration of skin is independent of its texture, and is a cue in itself (Fink, Grammer, & Matts, 2006). With skin texture and facial shape held constant, facial colouration still influences perceptions of age and attractiveness - for example, a face with an older skin texture is perceived as younger and more attractive if the colour distribution is homogenous. In non human animals, colour is an important signal for dominance (Setchell & Dixson, 2001), fertility (Setchell, Woekings, & Knapp, 2006) and immunocompetence (Lozano, 1994). In humans, faces with higher levels of oxygenated blood appear more healthy compared to faces with higher levels of deoxygenated blood (Stephen, Coetzee, Law-Smith, & Perrett, 2009). This redness is a cue to the blood flow in the skin, and by proxy, a cue to the cardiovascular health of the individual - oxygenated blood is linked with fitness (Armstrong & Welsman, 2001), and deoxygenated blood with illness (Ponsonby, Dwyer, & Cooper, 1997). Furthermore, blood flow to the skin is reduced in in patients with diabetes (Charkoudian, 2003), and who those smoke (Richardson, 1987), as well as in older adults (Tankersley, Smolander, Kenney, & Fortney, 1991). Other investigations of skin colouration have utilised the CIELab colour space, which is comprised of three channels, luminance, ($L*$, dark to light), alpha, ($a*$, green to red), and beta ($b*$, blue to yellow). This colour space is modelled on how the human eye perceives colour, yielding meaningful information when relating perceptions to skin colouration (Weatherall & Coombs, 1992). Stephen, Law-Smith, Stirrat, and Perrett (2009) found that a healthy appearance is linked with higher levels of redness ($a*$), luminance ($L*$) and yellowness ($b*$). While redness is associated with oxygenated blood perfusion (Stephen, Coetzee, Law-Smith, & Perrett, 2009), skin yellowness is, like in non human animals, associated with health (Stephen, Coetzee, & Perrett, 2011). Stephen et al (2011) demonstrated that there is a consistent preference for lighter and yellower skin across cultures, and that skin yellowness properties are related to carotenoids, phytochemicals responsible for the colouration of fruit and vegetables (Rao & Rao, 2007). Concordantly, individuals with a diet rich in carotenoids have a higher $b*$ skin values, and are rated as more healthy (Stephen, Coetzee, & Perrett, 2011).

Skin colouration plays a surprising role in attractiveness. A small patch of skin reflects whole face attractiveness (Jones, Little, Burt, & Perrett, 2004), and is a more reliable cue than shape information to an individuals health and attractiveness given the fact it can change over short periods of time, rather than reflecting health during adolescence, as more permanent shape cues do (Stephen, Scott, Coetzee, Pound, Perrett, & Penton-Voak, 2012). In females, where skin quality is at a premium (Samson, Fink, & Matts, 2010), certain colour qualities are perceived as more attractive. Interestingly, these relate to sexual dimorphism. Female skin is generally lighter than male skin, who typically possess darker and ruddier skin (van den Berghe & Frost, 1986). Higher levels of oestrogen in females results in smoother and lighter skin (Frost, 1988), which acts as a cue to reproductive potential (van den Berghe & Frost, 1986). Lighter skin allows more vitamin D synthesis, which is an important reserve for pregnancy (Jablonski & Chaplin, 2006). Considering this, it is no surprise that males have a preference for partners with lighter than average skin colour across cultures (van den Berghe & Frost, 1986; Swami, Furnham, & Joshi, 2008). This skin feature, which is highly desirable, is also related to real life outcomes. For example, in a sample of African American women, those with lighter skin earn more than their darker skinned peers, and are more likely to be married (Hunter, 2002). Among the same demographic, if an individual desires a different skin tone, it tends to be lighter, rather than darker (Bond & Cash, 1992). Further studies suggest that this luminance property is even more important than shape cues. Sadr, Fatke, Massay, and Sinha (2002) presented facial photographs of females that were blurred to different extents, and asked participants to rate their attractiveness. Surprisingly, attractiveness ratings assigned to clear, high-resolution images agreed strongly with the ratings assigned to even extremely degraded images. This suggests that low-pass-filtered information, most prominently the lightness of the skin, is a major predictor of attractiveness.

However, the face is not a uniform object. It possess a distinct configuration of luminance and colouration, in that the eyebrows, eyes and the mouth are darker than the surrounding skin. This unique contrast pattern has even been used successfully as an algorithm for computer face detection (Thoresz & Sinha, 2001). Given its distinctiveness, we might find that it plays a role in perceptions of attractiveness or social traits. Russell (2003) found that the relative luminance of facial features - the darkness of the eyes and lips compared to the lightness of the surrounding skin - is important for attractiveness in both male and female faces. By increasing the luminance difference between facial features and skin, female faces became more attractive, whilst the attractiveness of male faces was negatively impacted. When this luminance difference was decreased, the pattern was reversed, with males becoming more attractive with a smaller luminance difference. Importantly, these differences in attractiveness were unrelated to overall facial luminance - increasing the overall brightness of the image had no effect on ratings of attractiveness for faces of either sex (Russell, 2003).

Russell (2009) later further explored sex differences in these luminance differences, and found reliable differences. These luminance patterns, termed ‘facial contrast’, are different between males and females. Female faces have higher contrasts in general, even across race. Moreover, Russell (2009) demonstrated that an androgynous face can be made to appear male or female by increasing or decreasing the contrast between features and skin. Additionally, faces with higher contrasts are perceived as more feminine, while lower contrast is associated with perceptions of masculinity. Taken together, these studies establish facial contrast as a cue to sex typicality and attractiveness. Porcheron, Mauger and Russell (2013) also demonstrated that aspects of facial contrast decrease with age in female faces, indicating it is a cue to perceived age. Related, it may play a role in perceptions of fertility or female mate value. The body of literature on facial contrast has so far examined grayscale images (Russell, 2003; 2009) which is only loosely related to CIELab luminance (L^*). Porcheron et al (2013) utilised CIELab values as for calculating contrast, as well as incorporating the eyebrow into the model, a visually important feature for faces (Sadr, Jarudi, & Sinha, 2003). The current thesis marries these bodies of work, examining sex differences in facial contrast across colour channels, as well as incorporating the eyebrow as a source of contrast.

1.5 Putting your best face forward

Compared to males, whose mate value is clustered around resources and physical prowess (Cashdan, 1998; Tooke & Camire, 1991) female mate value is tied to their appearance. When questioned about how they compete with other women, the practices employed by women relate directly to attractiveness (Walters & Crawford, 1994). Females often adopt appearance oriented behaviours, such as revealing clothing, to enhance their attractiveness (Grammer, Renninger, & Fischer, 2004). The face is an especially critical cue for females (Thornhill & Grammer, 1999), signalling attractiveness, health and character traits. How might women enhance one of their most important cues of value?

It is no surprise that females have used of facial cosmetics for the majority of human history (Etcoff, 1999; Russell, 2010). Though understudied in the psychological literature, research has shown cosmetics demonstrably increase observer ratings of attractiveness, as well as increasing an individuals own estimate of her attractiveness (Cash, Dawson, Davis, Bowen, & Galumbeck, 1989). Furthermore, females likely use cosmetics in a personal way. Females with greater facial asymmetry spend significantly longer applying cosmetics, as well as using a broader palette of colours (Korichi, Pelle-de-Queral, Gazano, & Aubert, 2011). This is especially interesting, as it suggests individuals may use cosmetics in a manner to best downplay cues that are potentially unattractive, while optimising their attractive features. Whether this is done consciously is yet to be explored.

The effects of cosmetics on social cognition are intriguing as they extend beyond straightforward attractiveness. Instead, cosmetics have an effect on a number of social judgements. Nash, Fieldman, Hussey, Lévêque and Pineau (2006) found that when women had applied cosmetics, observers rated them as being healthier and more confident, as well as hailing from a higher socioeconomic background. Graham and Jouhar (1981) found similar results, and termed this perceptual enhancement ‘what is cared for is good’. Etcoff, Stock, Haley, Vickery, and House (2011) demonstrated further benefits of cosmetics on social perceptions. When applied, cosmetics significantly improved not only attractiveness, but perceptions of competence, likability, and even trustworthiness. This experiment is particularly interesting as it assessed four cosmetics looks, which ranged from none to a heavy application of cosmetics (a “glamorous” appearance; Etcoff et al., 2011). Ratings of attractiveness and competence increased linearly with the amount of cosmetics applied, but likability and trustworthiness were negatively impacted with increasing amount of cosmetics, and were instead optimal at lower levels. Indeed, other work demonstrates that cosmetics can actually be detrimental to perceptions of competence and ability (Cox & Glick, 1986). It is possible these perceptions are related to the halo effect, in which positive social outcomes are ascribed to those who are more physically attractive (Dion, Berscheid, & Walster, 1972) - in this case, those wearing cosmetics. Further research has highlighted this halo effect has a negative side. Dermer and Thiel (1975) found that while more attractive females were generally seen in a more positive light, they were also perceived to be more likely to be promiscuous and self centred, findings corroborated by others (Ashmore, Solomon, & Longo,

1996) who found attractive females were perceived as more cold, selfish and vain. Interestingly, some of these judgements may have a kernel of truth. Attractive females are sometimes more promiscuous (Boothroyd et al., 2011) and are less Agreeable (Wright & Reise, 1997). While cosmetic practices are beautifying and carry positive connotations, they also bring with them negative perceptions associated with increased attractiveness. There is also the possibility that if females use cosmetics to alter their appearance in ways which are beneficial to them socially, they might use cosmetics to manipulate signals or cues in the face to portray different personality characteristics. Consider that if red lips were a signal of Extraversion. Any individual female could make herself appear more outgoing than she actually is by applying cosmetics to her lips in a specific way. Furthermore, she may do this in a manner that is not inconsistent with her own ideals. For example, if a very introverted person appeared very outgoing, the responses of others around her may make her feel uncomfortable. Instead, she could manipulate her appearance in line with what she would be comfortable with - perhaps her ideal personality. Other studies have used this dissociation when examining online profiles, where people have the opportunity to portray themselves in any light they desire (Back et al., 2010). The current thesis examines this issue with cosmetics.

1.6 Origins and purposes of exaggeration

From an evolutionary perspective, cosmetic practices are interesting as they parallel the extended phenotypes of non human animals (Dawkins, 1989). The nest of the bower bird and a spider's web are but two examples that display the fitness of an organism, but are unrelated to its physical appearance (Etcoff et al., 2011). Human beings can manipulate phenotypic cues instantly using cosmetic technology (Russell, 2010). Relatedly, other lines of research have suggested cosmetics may be a form of supernormal stimuli (Barrett, 2010), which provoke an exaggerated response from an organism due to the exaggerated appearance of the stimulus. Birds peck more frequently and with greater force to stimuli such as a red knitting needle, mimicking the appearance and colour of the mother's beak (Tinbergen, 1953). There is similar evidence of behaviours in humans, relating to shape cues of attractiveness - the ideal female face possesses proportions that are so neotenous they border on physical impossibility (Johnston & Franklin, 1993). If cosmetics act in this way, what cues do they exaggerate?

There is a great deal of variance in cosmetics application across cultures (Russell, 2010). Yet, Russell (2010) identified a typical 'received style' of cosmetics that is prevalent across both cultures and history (Corson, 1972). This style involves darkening the eyes and mouth, while lightening the skin. Indeed, this is *precisely* the contrast pattern that Russell (2009) identified that is a powerful cue to sex typicality. It is extremely unlikely this would happen by chance, and despite cultural variation, it is still consistent - Russell (2010) illustrates that cosmetics are a form of technology, and much of the variance in cosmetics practices disappears when one considers the rate of technological advancement in the society of question. Furthermore, typical cosmetics practices have been utilised in multiple cultures at different points in time, evidenced by archaeological records (Chandra, 1973). This typical application of cosmetics, serving to increase the sex difference in facial contrast, also increases attractiveness. Mulhern, Fieldman, Hussey, Lévêque, and Pineau (2003) demonstrated that a cosmetics application that lightened skin with foundation and darkened the features with eyeliner, mascara and lipstick increased perceptions of attractiveness much more than just applying eye cosmetics or foundation alone. It is the consistent contrast manipulation and increase that is important. We can also speculate that the age related decline observed in feature contrasts (Porcheron et al., 2013) is reversed by cosmetics. Cosmetics also serve to smooth skin texture (Samson, Fink, & Matts, 2010), which is important for attractiveness.

Cosmetics are clearly used to enhance attractiveness, and with it, alter perceptions of other social traits. Who do women do this for? The vast majority of research assumes cosmetics are used by females to attract mates (Buss, 1988; Singh, 2004). Additionally, when resources are scarce, females show a greater inclination to purchase cosmetic products, presumably to attract males (Hill, Rodeheffer, Griskevicus, Durante, & White, 2012). However, females compete in terms of appearance (Campbell, 2004). This opens up an intriguing possibility - what if females use cosmetics use more to compete with other females than they do to attract males?

1.7 The current thesis

As discussed above, there is considerable evidence indicating that we make judgements of others based upon their face alone. Furthermore, these judgements are tied to aspects of facial morphology, surface texture, and colouration. Some of these judgements and facial qualities are linked, either signalling or cueing aspects of likely behaviour. Females use cosmetics to enhance their attractiveness, as well as alter perceptions of social traits. In doing so, they likely manipulate some of these facial qualities involved in signalling information. Currently, the use of cosmetics is an understudied behaviour in psychology, and there are numerous questions that remain unanswered. This thesis aims to explore at least some of these, as well as investigating other aspects of facial signals.

This thesis contains five experimental chapters. In Chapter 2, I investigate the presence of signals of personality in the face, with a specific focus on where the information might be carried - from posture, the viewing angle, or from the facial shape of the skin texture and colour. In Chapter 3, I extend the question of personality accuracy in the face to cosmetics, asking first whether cosmetics have an impact on a naive observers ability to accurately detect information, and second, whether cosmetics can be used by an individual to shift perceptions of themselves toward different attributes. In Chapter 4 I take a different, though related approach, examining how cosmetics change the perceptions of social traits in male and female observers, exploring the possibility that cosmetics may be used by females as a tool for intrasexual competition. Furthering this idea, I investigate how perceptions of attractiveness are affected by cosmetics over the lifespan of both consumers and observers. In Chapter 5, I examine a data driven hypothesis of the use of cosmetics. There, I take a social psychology approach and examine whether the use of cosmetics is the result of misattributions of attractiveness ideals. Chapter 6 goes some way to investigating the function of cosmetics from a lower level visual perspective. Here, I investigate sex differences in feature contrasts across CIELab colour channels in an extensive set of face stimuli. I then examine how these sex differences relate to the changes that occur after a typical application of cosmetics. In the final chapter, the experimental findings are discussed in relation to biological systems and cues, as well as socio-evolutionary account of cosmetic practices. Furthermore, I address potential applications of the research.

CHAPTER 2: Signals of personality and health: The contributions of facial shape, skin texture and viewing angle [1]

Abstract

To what extent does information in a person's face predict their likely behaviour? There is increasing evidence for association between relatively neutral, static facial appearance and personality traits. By using composite images rendered from 3D scans of women scoring high and low on health and personality dimensions, we aimed to examine the separate contributions of facial shape, skin texture and viewing angle to the detection of these traits, whilst controlling for crucial posture variables. After controlling for such cues, participants were able to identify Agreeableness, Neuroticism and Physical Health. For personality traits, we found a reliable laterality bias, in that the right side of the face afforded higher accuracy than the left. The separate contributions of shape and texture cues varied with the traits being judged. Our findings are consistent with signalling theories suggesting multiple channels to convey multiple messages.

2.1 Introduction

The notion that our character can be read from our face has been widespread throughout history, with examples littered throughout plays and novels. These concepts of folk physiognomy are often discouraged, centred around the belief that such judgements are inaccurate and unfair. However, recent work suggests these perceptions can be surprisingly accurate. A class of "controllable" cues (Mazur, 2005) such as posture, clothing, and facial

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[1] This research appears in print:
Jones, A. L., Kramer, R. S. S., & Ward, R. (2012). Signals of personality and health: The contributions of facial shape, skin texture, and viewing angle. *Journal of Experimental Psychology: Human Perception and Performance, 38*(6), 1353-1361.

expressions (e.g. smiling) are easily detectable and largely under volitional control, and can convey accurate, readily available information about the sender (Naumann, Vazire, Rentfrow & Gosling, 2009). More surprisingly, judgements are also accurate from very brief exposures to ‘thin slices’ of nonverbal behaviour. For example, people are accurately able to predict the quality of an individuals interpersonal relationships from these small exposures (Ambady & Rosenthal, 1992).

There is growing evidence for another class of “constant” cues, which are not under dynamic control (Mazur, 2005), but can still allow accurate perception of personality. In fact, the static, non-expressive face can be all that is needed for accurate personality judgements of many types to be made, including dominance (Mueller & Mazur, 1997), aggression (Carré, McCormick & Mondloch, 2009), sociosexuality (Boothroyd, Jones, Burt, DeBruine & Perrett, 2008), trustworthiness (Stirrat & Perrett, 2010), political affiliation (Rule & Ambady, 2010) and sexual orientation (Freeman, Johnson, Ambady & Rule, 2010).

Personality research identifies the factors that best characterise how stable biases in behaviour differ between individuals. Five-factor (or “Big Five”) models of personality have proven to be robust and reliable descriptions of these individual differences (Goldberg, 1993). It is therefore highly interesting that many of the Big Five traits can be accurately perceived from the static non-expressive face, both in photographs of individuals (Penton-Voak, Pound, Little & Perrett, 2006), and in composite images of people with similar personalities (Kramer & Ward, 2010; Little & Perrett, 2007). Composites created from individuals who score low or high on Big Five traits are often identified accurately, especially in female faces (Kramer & Ward, 2010; Little & Perrett, 2007; Penton-Voak et al., 2006), for the traits of Extraversion, Neuroticism, and Agreeableness. Male faces are more difficult to read, with Little and Perrett

(2007) demonstrating accurate identification of only Extraversion. A very important point is that accurate identification does not appear to result from perceptions of attractiveness. Specifically, Kramer and Ward (2010) had participants discriminate between high and low composites for different traits and rate the attractiveness of the different composites. They rejected the possibility that raters were assigning socially desirable traits (e.g., high Agreeableness) to the more attractive face. In fact, accuracy for individual raters was not predicted by their ratings of facial attractiveness.

Results with composite images are especially interesting, as accurate personality identification from composites indicates that people with similar personalities share a similar facial appearance. Consider that Agreeableness could be identified from an individual face, but any individual face expressed Agreeableness in an idiosyncratic manner. If a composite image were then made from people of high Agreeableness, the signal for the trait would be lost, being proportionally reduced for every face in the composite. Conversely, if high Agreeableness were reflected in similar facial properties across individuals, a composite of those individuals would express those shared properties and “agreeable” appearance.

The findings with composites therefore suggest that people with similar personalities can share similar facial appearances, and further, that naive observers can accurate identify associations between appearance and personality. However, these findings do not address some key issues. A possible alternative explanation of previous findings is that the signal for personality is not in the face, but in the posture of the head - that is, slight deviations of the head from a straight-ahead, upright position. Head posture alone can signal a wide array of information. Mignault and Chaudhuri (2003) demonstrated strong influences of just slight head tilt on perceptions of many traits from a face with a neutral expression. For example, faces which were bowed were more likely to be perceived as experiencing sadness, feeling inferior, and being submissive (Tiedens & Fragale, 2003). Those with heads raised are perceived as being more dominant (Otta, Lira, Delevati, Cesar & Pires, 1994). All of these effects are apparent after inflections of just 5º in either direction, and the effect is compounded with a larger postural difference.

Experimenters attempt to control for posture when taking photographs, and ask participants to look directly ahead at the camera, so that large deviations from the standard position would be avoided. However, subtle differences in the angle of the head outside the picture plane could have important effects. For example, if those low in Agreeableness posed for a neutral photograph with their chins raised slightly more than others who are high in Agreeableness, then the posture would validly signal personality, but not the facial features themselves. In this example, the 2D projection of the different postures (chin raised or lowered) would produce artefactual differences within the facial image, such as the apparent size of the chin and height of the eye-line. This is illustrated in Figure 1. Furthermore, if these differences are consistent across individuals, posture will have effects even in composite images in spite of any subsequent manipulations (e.g. cropping) such as in the hypothetical Agreeableness example above.

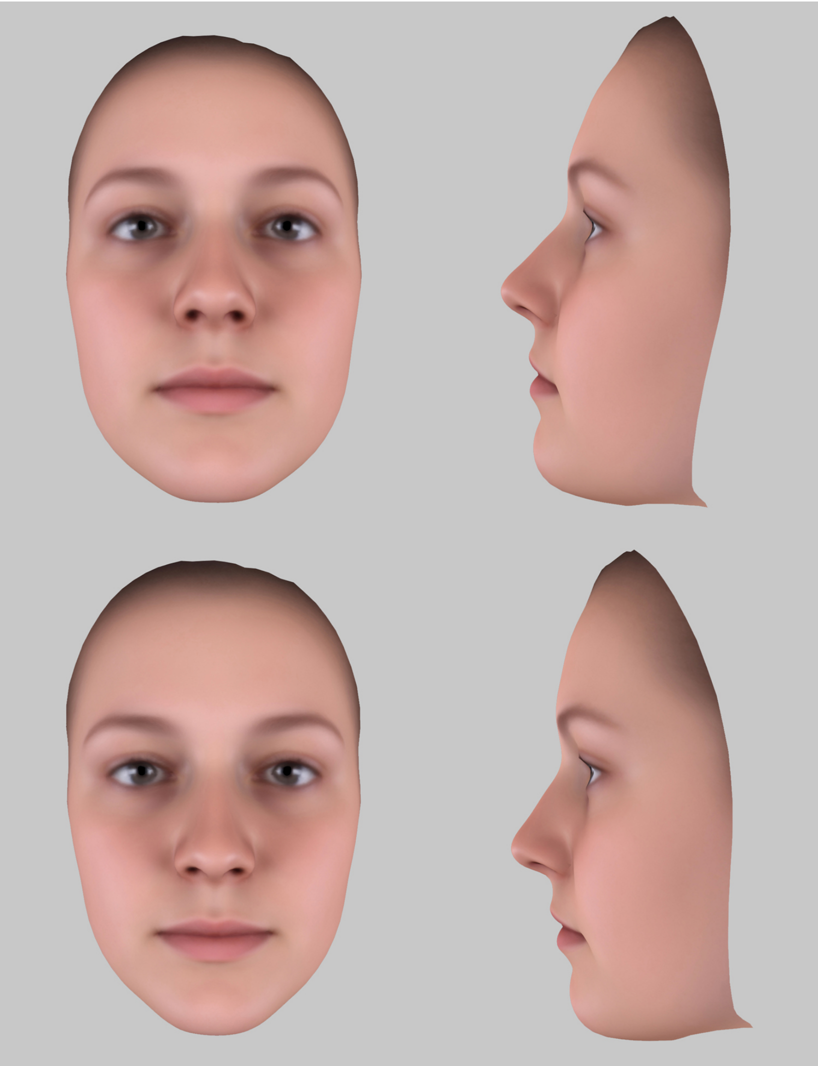

Figure 1. An example of how minor changes in head tilt affect face perceptions. The left column shows the different 2D projections that result when the same face model is tilted according to the right column. The top tier images display a postural tilt of -5º, whereas the lower two images have been manipulated by +5º.

Fundamentally, making facial composites of individuals in order to capture their shared facial traits assumes that the posture of the head in all photographs is identical outside the picture plane, which it surely is not. Personality in facial photos might be accurately identified by observers, not by subtle facial shape or facial surface features, but by differences systematically related to personality, in the way the head is held for the photograph.

Addressing this possibility is therefore important, but not necessarily simple. In theory, one approach might be to give participants a bite-bar or head clamp, in order to fix position and angle of the head to a known value before taking the photograph. An approach like this would increase the uniformity of head posture, but at a cost of increasing muscular tension in the face, obscuring important regions of the face, and creating a highly unnatural context for a simple photograph.

The approach we take here is to use 3D facial scanning. In this process, a 3D model of the head is captured, in our case through the use of simultaneous images taken by multiple cameras at known positions. The resulting 3D models can then be rotated to arbitrary angles relative to their position at the time of their original capture. Rather than simply assuming that posture of the head is identical in all photos, the 3D models can be brought into a common alignment that minimises any postural differences.

The 3D-scan creates a model of the geometry of the face separate from its surface texture. The shape of the face is based on the underlying skeleton, muscle, adipose, and skin layers; while texture refers to surface features like colour of the skin and lips, and features of the eyebrows (an analogous separation of 2D shape and surface is possible with traditional photograph composites). We can readily use this separation of information sources to investigate whether shape and surface offer redundant or distinctive information about personality from the face.

We do not know of any investigations looking at the contributions of facial shape and surface to personality identification, however, some studies have shown differing perceptions of attractiveness when these features are manipulated. Said and Todorov (2011), using mathematical modelling, have demonstrated differing influences of facial shape and surface features on attractiveness. Using the results from a principal components analysis, faces can be made more or less attractive by altering the position of the face along these dimensions. Interestingly, male faces can become more attractive by having their shape feminised, but their skin texture is optimally attractive when more masculinised (i.e., darker and with more facial hair). For females, optimum attractiveness is unidirectional toward the more feminine attributes. Conversely, Little and Hancock (2002) found separate contributions of shape and texture to attractiveness, in that males with smoother skin textures (i.e., more feminine) were rated as more attractive, along with those who possessed the average masculine face shape.

Additionally, recent studies have demonstrated that facial colour influences perceptions of health. Carotenoid colouring is associated with higher intakes of dietary vegetables and fruit, and is perceived as attractive and healthy by a wide sample of populations (Stephen & McKeegan, 2010). Additionally, increasing facial redness (Stephen, Law-Smith, Stirrat & Perrett, 2009) increases attractiveness (Stephen, Coetzee, Law-Smith & Perrett, 2009). It may be that personality perceptions can be influenced by skin texture also.

The control of stimulus orientation that is possible with the use of three-dimensional stimuli has another advantage: We can readily manipulate the viewing angle of the presented stimulus. A body of research has found laterality effects in perceptions from the face. Generally, the left side of the face is rated as more expressive (Nicholls,Wolfgang, Clode & Lindell, 2002), and actually expresses emotions more intensely (Sackeim, Gur & Saucy, 1978). Despite this, Butler et al. (2005) found that participants gaze at the right side of an actor's face first, and for longer. It is this same side that influences perceptions of attractiveness, sex and age (Burt & Perrett, 1997). Because there seem to be systematic (or directional) asymmetries within the face, it may be that personality information is also lateralised. In the one study involving laterality and personality identification, Kramer and Ward (2011) used hemiface stimuli to argue that accuracy for personality traits was greater from the right side of the actor's face than the left. However, hemiface stimuli are at best an unusual view of the face. Although precise positioning of a real face to specific angles is difficult to achieve, we can create naturalistic views of 3D face models to desired viewing angles.

The possibility that information in the face allows accurate decoding of personality is intriguing and suggests new avenues for visuo-social cognition. To summarise our aims, the present study examines whether the information for accurate identification is in the face or posture. We take advantage of the versatility of stereophotogrammetry to explore the possibilities of separate contributions of facial shape and texture, and of different information in the left and right sides of the face, as demonstrated with hemifaces (Kramer & Ward, 2011).

2.2 Method

2.2.1 Stimuli

Personality assessment and photographic capture. A group of 242 Bangor students (151 females, age M = 21.33, SD = 3.76) were recruited for stimulus creation. Participants indicated ethnicity based on the UK 2011 Census form question. Each participant completed the Big Five Inventory 44 (BFI-44; John & Srivastava, 1999) in order to obtain measures of personality. They also completed the 12-Item Short Form Health Survey (SF-12; Ware, Kosinski & Keller, 1996) to measure physical health. The SF-12 can be considered to be a measure of health in daily living, rather than a multidimensional construct (Eberst, 1984). Finally, facial images of each participant were captured in collaboration with Di3D (Dimensional Imaging Ltd, UK), using their FCS-100 system. This consisted of four 10 mega-pixel cameras placed around a calibration board, allowing for the simultaneous capture of four images from different locations of known separation. These high-resolution images were then merged using Di3D passive stereophotogrammetry software, which combined the images to produce high-resolution texture maps and 3D models of the participant. All participants were photographed with a neutral expression, at a fixed distance to the camera, and with their hair pulled back from the face as much as possible, with cosmetics and jewellery removed. Females who reported their ethnicity as white, with neutral expressions ($N = 92$, age $M = 21.1$, $SD = 3.29$) were used.

Three-dimensional scan standardisation and landmarks. Due to the individual nature of facial structure, each scan differed in its number of vertices. In order to create averages, each scan had to have its number of vertices standardised, accomplished by conforming each 3D model to a high resolution template containing 4,735 vertices. This was achieved using the Di3Dtransfer tool with a series of 48 landmarks which were manually identified on the individual 3D model and the template to increase the accuracy of the transfer (Figure 2). The landmarks were partly based upon the landmarks used in JPsychomorph (Tiddeman, Burt & Perrett, 2001), a 2D morphing software. Other points were based upon prominent and easily identifiable features of the face, for example, the eyebrow ridges, or tip of the nose. Landmarks such as the widest points on the nose could be reliably found by moving the scan through principal planes and land-marking the point that broke the planar surface first. Due to the reflective texture of the human eye, the camera flash caused it to appear concave. Many landmarks were added around the eyes in order to reduce this effect when the composites were created. Using the Di3Danalyse tool, all resulting meshes had an alignment error under 0.5 mm of the original scan, meaning all vertices of the fitted meshes were identical to the original scan within 0.5 mm. This process ensured that each face was oriented to best fit the standardised template. So for example, the original model for a participant tilting their head slightly down and left would be fit to the standard template facing directly forwards, mitigating subtle postural differences between participants. Once the morphometry of the original scan was standardised to the vertices of the template, a surface map was created using the Di3D software, mapping pixel values in the camera images to vertices in the standardised model. An important point is that the process creates a separate 3D model and surface texture for each participant, allowing us to separate these cues.

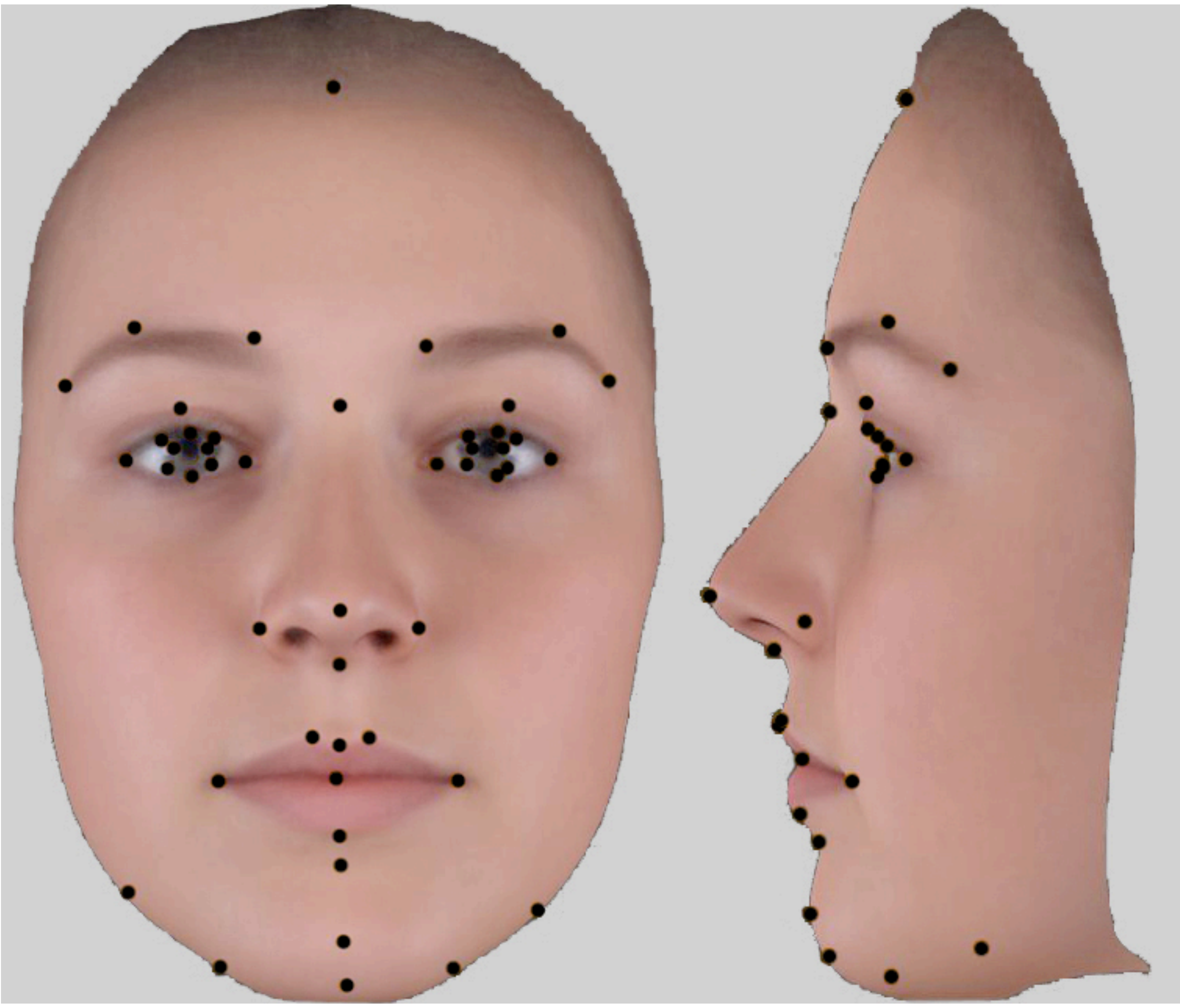

Figure 2. A composite female face displaying the set of 42 landmarks used.

Composite stimuli creation. Composite 3D images were created for each trait by taking the standardised models of the 15 highest and lowest female scorers for each trait. The high and low composites were created by separately averaging the standardised models for each group using Morphanalyser (Tiddeman, Duffy & Rabey, 2000) software. Composites were created by looping through the standardised vertices of each face within the group, and calculating the average position of each vertex. The resulting 3D objects were then further manipulated in Cheetah3D (3D3 Solutions, Vancouver, Canada) to produce renders in three views (see Figure 3) with standardised artificial lighting and viewing angle. Faces were turned 45° to the left along the Heading (H) axis, so that their right side was displayed to the viewer (Right View), and then rendered to create a 2D stimulus image (Figure 3). Conversely, they were turned 45º to the right along the H axis, displaying their left side (Left View) to the viewer, where they were rendered. Composite models were also rendered from the front, with zero rotation on the Heading-Pitch-Bank (HPB) axes. The field of view was set to 60°, with a perspective projection. The approximate camera distance from the face was 150% of the face height. The camera was placed at 0° along the X axis, -0.05° along the Y axis and 1.5° along the Z axis within the camera settings. For every render, their orientation along the P and B axis were kept at 0°, ensuring their posture was identical.

Figure 3. Example stimuli. The facial composite for high Agreeableness demonstrating the Left, Front and Right views respectively.

Shape Alone and Texture Alone models. As described earlier, the process of stimulus production creates separable 3D object models and surface textures. In order to assess the separate contributions of skin texture and facial structure to trait perception, an average female face was produced using Morphanalyser (Tiddeman, Duffy & Rabey, 2000) from all 92 individual face models. The textures of the high and low trait composites were then each applied to the average facial shape. This yielded 24 face models that differed in surface texture but shared the same averaged 3D shape. We refer to these as our "Texture Alone" models, not because texture was presented without shape, but because only texture differed between the high and low composites. In an analogous way, we created our "Shape Alone" models. In this case, we applied the average texture to the 3D shape of the high and low trait composites. These 24 models therefore shared a common texture but unique shape. In this way, the contributions of structure and texture could be controlled and assessed separately (O'Toole, Price, Vetter, Bartlett & Blanz, 1999), as well as compared to the "Combined" models, which reflected both the shape and the texture information for high and low trait composites.

2.2.2 Participants

Forty-four participants (25 females, age M = 24.30, SD = 5.79) from Bangor University took part in the study for a payment of £6 and course credits.

2.2.3 Design

Three factors defined the experimental design and stimulus presentation: View (Left, Front, Right) x Information Source (Combined, Shape Alone, Texture Alone) x Trait (Agreeableness, Conscientiousness, Extraversion, Neuroticism, Openness and Physical Health). All factors were varied within participants. Trials were blocked by View, and the order of blocks was counterbalanced across participants.

2.2.4 Procedure

On each trial, high and low trait composites were presented on the left and right of the screen (approximate image size of 18 x 21 centimetres, 550 x 600 pixels, with a viewing distance of approximately 50 cm but not fixed). The experimental factors of View, Information Source, and Trait were held constant for each pair. Participants were asked to judge which face better suited a discrimination statement (e.g., “more talkative”) appearing above the faces, and to indicate their response with an unspeeded mouse click. For personality traits, the discriminatory statements were adapted from the BFI-44 (John & Srivastava, 1999). For physical health, the eight questions contributing the most weight to the physical health score from the SF-12 (Ware, Kosinski, & Keller, 1996) were used. Discrimination statements were adapted so that of the eight statements for each trait, the correct responses for four of the statements reflected high social desirability (indicating high levels of Agreeableness, Conscientiousness, Extraversion, Openness, and Health; and low levels of Neuroticism; e.g. ‘more interested in others’ feelings’) while the other four were low in social desirability (e.g. ‘more cold and aloof’). When the statement was high in social desirability, two of the trials had the correct answer on the left of the screen and two had the correct answer on the right. The same counterbalancing was true for the trials with low social desirability statements. Each of the eight discrimination statements for a trait, along with its corresponding pair of high and low trait composites, appeared once within a block for a total of 432 trials.

2.3 Results

There were three main findings. First, while mitigating any postural effects, we largely replicated previous findings demonstrating accurate trait perceptions from the face (Kramer & Ward, 2010; Little & Perrett, 2007). That is to say, for many traits, people with similar personalities share a similar facial appearance. Second, we found that information allowing accurate personality identification is largely lateralised to the right side of the face. Third, we found significant and separate contributions of facial structure and skin texture for many cases of accurate trait identification.

The focus of the study was to determine the effects of view, texture and shape on the accuracy of individual trait identification. Our plan for analysis was therefore to consider the effects of View and Information Source separately for each trait. We consider the significant findings for each trait below; however, means and variance measures for all conditions are provided in Appendix I.

2.3.1 Individual Trait Accuracy

Agreeableness. We first consider which of the conditions produced above chance performance for Agreeableness, illustrated in Figure 4. For the Front and Right views, all conditions were significantly above chance, all *ps* $< .003$. However, within the Right View, the Shape Alone condition was just significant, $t(43) = 2.06$, $p = .045$, as was the Texture Alone $t(43) = 2.31$, $p = .026$. In the Left View, only the Texture Alone condition was above chance, $t(43) = 3.17$, $p = .003$.

A 3 (View: Front, Left, Right) x 3 (Information Source: Combined, Shape Alone, Texture Alone) ANOVA revealed a main effect of View, $F(2, 86) = 8.50$, $p < .001$, and a View x Information Source interaction, $F(4, 172) = 3.30$, $p = .012$. Inspection of Figure 3 strongly suggests this is driven by the chance performance of most conditions in the Left View. Indeed, the mean accuracy for the Left View was $M = .52$, while for the Right View it was $M = .58$, and for the Front View it was $M = .61$.

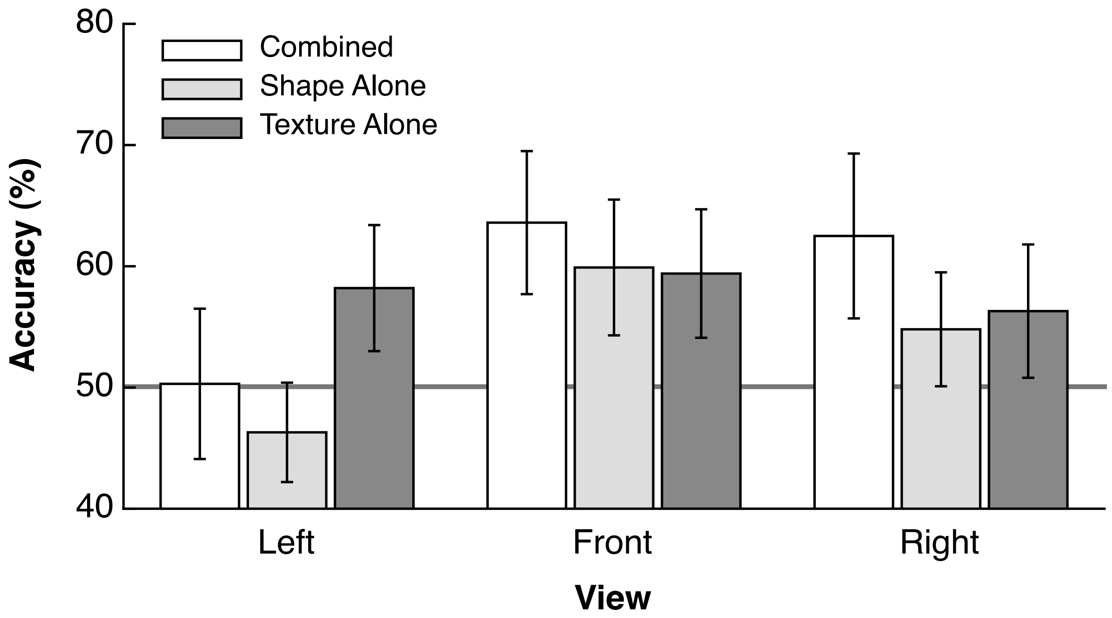

Figure 4. Accuracy on two-alternative forced choice discrimination of Agreeableness. Error bars represent a 95% confidence interval, and conditions with error bars crossing the 50% line are not significantly different from chance.

Conscientiousness. No significant main effects or interactions were found, all *p*s > .05. Accuracy for this trait is typically around chance levels in other studies involving full face composites (Kramer & Ward, 2010; Little & Perrett, 2007).

Extraversion. Only two conditions were significantly different from chance (Figure 5). The Texture Alone condition was significantly accurate with both the Front View, $t(43) = 2.79$, $p = .008$, and Right View, $t(43) = 4.05$, $p < .001$.

A 3 x 3 ANOVA revealed a significant main effect of View, $F(2, 86) = 4.28$, $p = .017$, with the Left being less accurate, $M = .49$, than the Right, $M = .55$, or Front Views, $M = .54$. There was a main effect of Information Source, $F(2, 86) = 5.50$, $p = .006$, and, as Figure 5 demonstrates, this was driven by Texture Alone conditions, suggesting that texture may play a role in the perception of Extraversion. Although previous studies with composite images have found high levels of accuracy for identifying Extraversion (Little & Perrett, 2007; Kramer & Ward, 2010), performance was little different from chance with our posture-controlled stimuli.

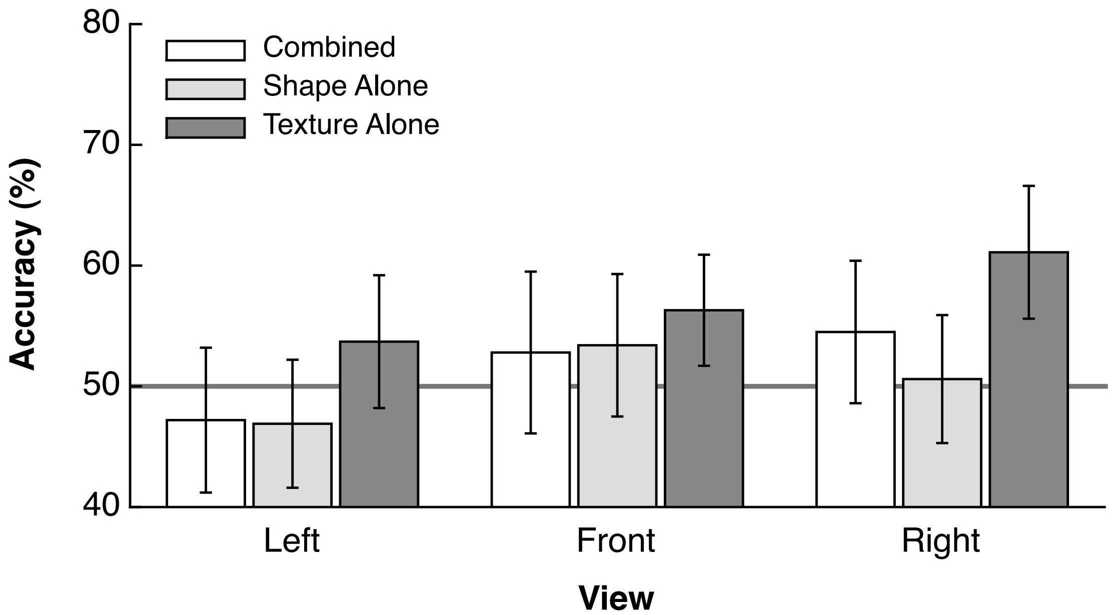

Figure 5. Accuracy on Extraversion. See Figure 4 for details.

Neuroticism. Results for Neuroticism are shown in Figure 6. For the Front and Right Views, all conditions were significantly above chance, all *p*s < .015. In the Left View, only Shape Alone was significant, $t(43) = 4.32$, $p < .0001$, with the Combined condition just failing to reach significance, $t(43) = 1.97$, $p = .055$.

A 3 x 3 ANOVA demonstrated a significant main effect of View, $F(2, 86) = 3.55$, $p = .033$, demonstrating a difference in accuracy across Views, with lower accuracy in the Left View, $M = .57$, compared to the Right and Front Views, $M = .61$, and $M = .62$, respectively. A significant interaction between View x Information Source, $F(4, 172) = 3.38$, $p = .011$, was also present. Figure 6 suggests this interaction was mostly driven by the chance performance of most factors in the Left View.

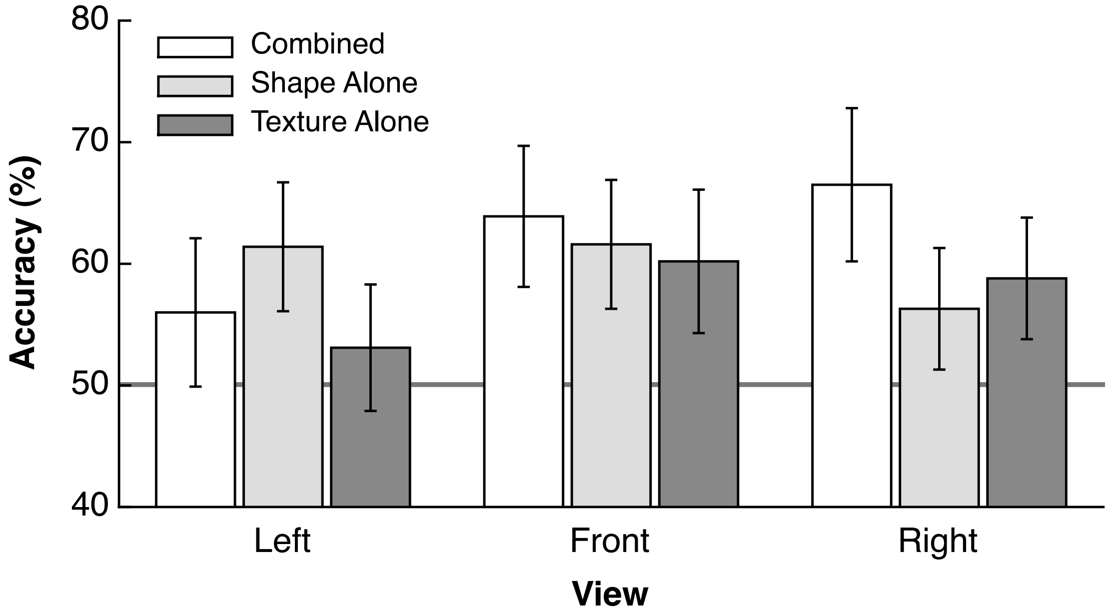

Figure 6. Accuracy on Neuroticism. See Figure 4 for details.

Openness. No main effects or interactions were found, all *p*s > .05. Accuracy was never significantly different from chance, all *p*s > .05. Other studies show similar accuracy for this trait (Kramer & Ward, 2010).

Physical Health. Results for Physical Health are given in Figure 7. Physical Health was accurately detected across all Views and Information Sources, all *p*s < .05. In the Right View, however, the Shape Alone condition failed to reach significance, $t(43) = 1.18$, $p = .25$.

A 3 x 3 ANOVA demonstrated a significant main effect of Information Source, $F(2, 86) = 6.51$, $p = .002$, showing a difference in accuracy across Information Sources. Accuracy on Shape Alone ($M = .56$) was less than Texture Alone ($M = .62$) and the Combined condition ($M = .63$).

Finally, across all the traits tested, we found no main effects or interactions involving sex of the observer, suggesting men and women showed equivalent accuracy when judging faces.

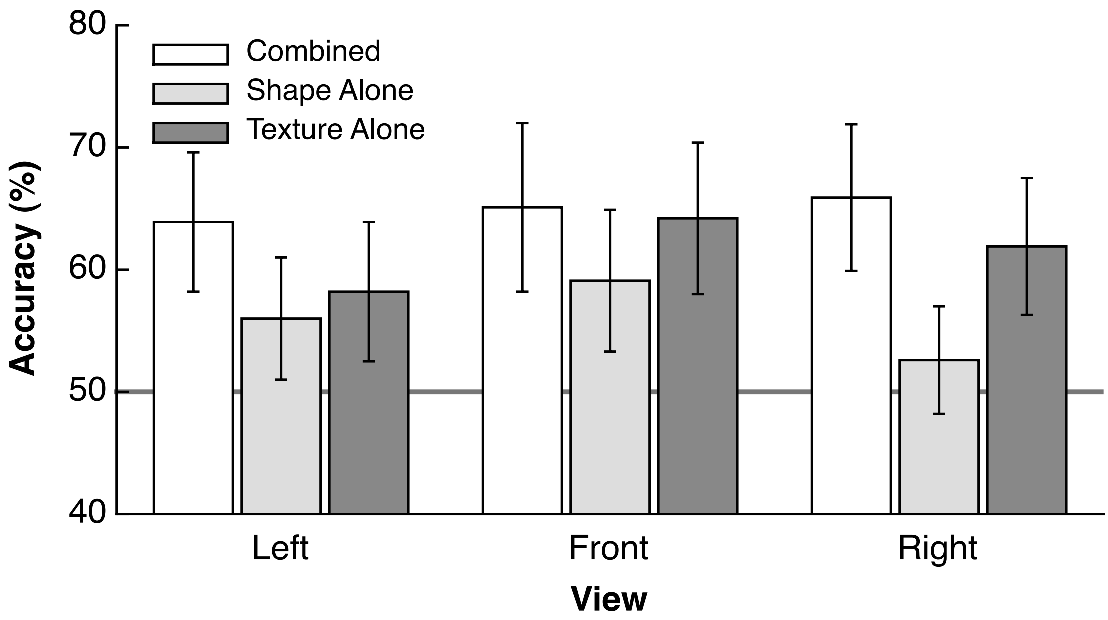

Figure 7. Accuracy on Physical Health. See Figure 4 for details.

2.4 Discussion

Previous studies have claimed to find accurate detection of personality traits and health from neutral, static facial images (Kramer & Ward, 2010; Little & Perrett, 2007; Penton-Voak et al., 2006). Here, we have eliminated potential postural cues to convincingly demonstrate that the face does accurately signal some personality traits, as well as health. We have identified differences between the two sides of the face in the expression of traits, and demonstrated that facial shape and skin texture make different contributions to the expression of different traits. We now take a broader perspective, looking for regularities across the different traits and viewing conditions.

First, how do our results compare to previous studies? Previous studies have been limited to the subset of conditions defined by our Front View and Combined Information stimuli (Kramer & Ward, 2010; Little & Perrett, 2007). Our results with controlled postures in the Front/Combined conditions are qualitatively similar to those obtained by Kramer and Ward (2010): accurate identification of Agreeableness, Neuroticism, and Physical Health; and chance performance on Conscientiousness and Openness. The exception appears to be Extraversion. Although Extraversion was identified at high levels of accuracy in both Little and Perrett (2007; their high extravert composite was rated as .53 units higher on average than their low extravert composite on a 7 point Likert scale for perceived extraversion), and Kramer and Ward (2010; mean accuracy of 87.5%, using a two alternative forced choice as utilised here), this trait was largely at chance levels with our posture-controlled stimuli (Figure 5). We suggest that posture is an important cue to Extraversion in facial photos. Systematic variation in posture will necessarily produce changes in the projection of 2D shape, but would be expected to have relatively less impact on global texture variables such as colour (although it could impact features such as the apparent arch of the eyebrow). With the sources of any postural cue eliminated in our stimuli, judgements of Extraversion from shape alone were no different from chance, leaving only a small cue to Extraversion remaining in texture. The differing patterns of accuracy we find from shape and texture are therefore consistent with the possibility that previous demonstrations of accurate Extraversion identification may be due to posture.

Although Extraversion appears to be signalled largely from posture rather than from the face, as a whole our results confirm that the face can reliably signal personality and health information. Across the studies by Little and Perrett (2007), Kramer and Ward (2010), and the present study, we have independent samples, using different but related measures of personality, and very different methods of image capture and stimulus construction, which all demonstrate that cues to Agreeableness and Neuroticism are present in the face.

For the personality traits which could be accurately identified (Agreeableness and Neuroticism), accuracy for the left side of the face was significantly less than for the front and right Views. Even with Extraversion, the small cue from facial texture appeared to be larger on the right than the left. What might be the cause of such differences? Previous research has shown the left side of the face is rated as more emotionally expressive than the right, even from turns of the head as small as 15°, and especially in female faces (Nicholls, et al., 2002). Additionally, Wylie and Goodale (1988) demonstrated greater musculature displacement of the left side of the face during spontaneous smiles when compared to the right. Indeed, it seems the bias towards expressiveness in the left side of the face is innate: people asked to express as much emotion as possible for a family photograph consistently display their left side more prominently (Nicholls, Clode, Wood & Wood, 1999). Additionally, research involving non-human primates has found similar directional asymmetries, with the left side more expressive (Fernández-Carriba, Loeches, Morcillo & Hopkins, 2002). If the left side of the face therefore carries more dynamic information about current mood and mental state, then the right side may correspondingly carry more stable trait signals. Consistent with this possibility, people look at, and gaze longer, at the right side of the face when forming initial impressions of sex, age and attractiveness (Burt & Perrett, 1997; Butler et al., 2005).

At this point, we think it is unlikely that the laterality effects we found resulted from hemispheric asymmetries in the observers. Although a frequent finding is that the right hemisphere demonstrates some degree of specialisation or fluency for faces as compared to the left hemisphere (Ashwin, Wheelwright & Baron-Cohen, 2005; Kanwisher, McDermott & Chun, 1997; LeGrand, Mondloch, Maurer & Brent, 2003), this does not account well for our results. First, hemispheric differences in face processing are commonly found under conditions of brief exposure and controlled fixation, which maximise the impact of a lateralised stimulus on one cerebral hemisphere (McCarthy, Puce, Gore & Allison, 1997), rather than the unlimited, free viewing conditions used here. Second, from the observer’s perspective, in the Left View, important facial features like the eyes, eyebrows, lips, and chin all appear on the left side of the stimulus object (see Figure 3). If, as seems unlikely under our viewing conditions, visual information did impact on one hemisphere more than another, then facial features would have been more directly engaged by the right hemisphere on Left View faces than Right. That is, an account based on right-hemisphere specialisation for faces in the observers would predict better performance in the Left than Right view conditions. Finally, recent work on hemifaces (Kramer & Ward, 2011) identified no differences in perceptions concerning normal or mirrored faces. This suggests that the signalling content of the faces is important, and is not explained in the way in which the observer processes them (Burt & Perrett, 1997). Currently, our results with viewing angle therefore suggest there are directional asymmetries in the face, such that information about a variety of personality traits are more reliably expressed on the right side.

In contrast to these results with personality, Physical Health was accurately identified without evidence for any lateralisation, as accuracy was comparable across all viewing angles, especially in the Combined condition. Additionally, the accuracy of physical health was greater from texture than from facial shape. Since colour is present in both the Texture Alone and Combined condition, it supports previous research on the value of colour signals for health perception (Stephen et al., 2009). However, an important extension of the present study is demonstrating that surface features of the face go beyond simply giving an impression of health, but actually allow accurate identification of true levels of health in daily living.

Finally, the more informative information source (shape or texture) depended on the trait being identified. For Agreeableness, Extraversion, and Physical Health, texture was the better cue; while for Neuroticism, shape was more reliable. As expected, accuracy was highest in the Combined condition, which provided both shape and texture cues. Although we did see instances in which a single cue was numerically superior to the combined cue (e.g., Extraversion), we did not find any strong evidence of conflicting cues, in which the Combined condition was significantly less accurate than a single cue alone. These results are therefore consistent with a trait signalling system utilising multiple channels to communicate multiple messages about the signal sender. These messages are correlated with the sender's condition and can be assembled by the receiver to gain an overall more accurate impression of the sender (Zuk, Ligon & Thornhill, 1992). Not only do we find different personality traits signalled through different channels in the present research, but shape and texture have been shown elsewhere to communicate different kinds of messages. For example, previous work has demonstrated colour in the texture of a face leads to perceptions of health through blood perfusion (Stephen et al., 2009). Additionally, increases of skin luminance increase attractiveness and perceptions of sex (Russell, 2009), while increases in lip colour also influence attractiveness and femininity (Stephen & McKeegan, 2010). Whilst colour is a signal of health in the face, texture also contains a variety of other information, such as eyebrow shape and position, which interplay with shape information and convey signals of dominance and masculinity (Gangestad & Thornhill, 2003). Indeed, aspects of colour such as the attractiveness of red lips rely on shape for their boost in attractiveness: full lips are universally more attractive than thin lips (Bisson & Grobbelaar, 2004). Shape in itself signals a great deal of information through adiposity (Coetzee, Perrett & Stephen, 2009), which indicates health, while high width-to-height ratios are robust predictors of aggressiveness (Carré et al., 2009). Considering there are multiple sources of information, an implication is that individuals will need to attend to different areas and features of the face, based on the nature of the personality assessment.

Even a "neutral" photograph is the result of a social interaction, and nonverbal signals including head posture are apparently used during this interaction to signal some aspects of personality. In addition to this kind of "controllable" posture cue, our results confirm that facial features alone can also signal personality. Such correlations between facial appearance and personality seem likely to be important targets for social cognition and perception systems.

The next step

Given the evidence from this chapter that both skin texture and facial shape play a role in accurate identification of personality, I decided to investigate how cosmetics influence the perception of traits from the face, and whether accuracy exists in individual faces, which is understudied.

CHAPTER 3: Cosmetics use changes perception in line with ideal personality traits but does not affect accuracy

Abstract

Personality can be read from a neutral face, especially in women. The majority of women employ the use of facial cosmetics, but does this practice have any effect on an observer's ability to read their personality? By photographing women with and without cosmetics, we examined whether cosmetics had an effect on reading actual and ideal personality. We found no significant differences in accuracy between conditions for Extraversion, Emotional Stability and Openness, but demonstrate that cosmetics can shift observer perceptions towards some ideal traits. Our findings suggest cosmetics do not change the relative strength of personality cues, but may allow women to appear more like who they want to be, rather than who they are.

3.1 Introduction

The use of cosmetics is a widespread human behaviour occurring across human cultures (Jablonksi, 2006). Indeed, cosmetics serve to increase female facial attractiveness by manipulating biological bases of beauty. For example, cosmetics reduce the appearance of fluctuating asymmetries (Korichi, Pelle-de-Queral, Gazano, & Aubert, 2011), as well as homogenising skin texture to increase perceptions of youthfulness (Samson, Fink, & Matts, 2010).

The application of cosmetics follows a typical pattern, and this ‘received style’ (Russell, 2010) increases attractiveness by manipulating the sexual dichromacy of the human face. Research has demonstrated that females have lighter skin than males (Jablonski

& Chaplin, 2000). Indeed, males prefer females with a lighter than average skin tone, while females conversely prefer males with darker skin tones (Frost 1989; Swami, Furnham, & Joshi, 2008). While the definitive basis for such a sexual dichromatism is not fully understood (for a review, see Samson et al., 2009), cosmetics can reliably increase the attractiveness of the human female face by exaggerating these contrast differences. Russell (2009) localised this dichromacy in facial contrast to the difference in feature luminance and skin luminance. By altering this contrast, an androgynous face can be made to look female or male. When subsequently comparing photographed faces of a sample of East Asian and Caucasian females, before and after being instructed to apply cosmetics for a night out, it was found that the models manipulated precisely these facial attributes (Russell, 2009). Foundations increased skin luminance, and eyeliners, mascara and lipstick reduced feature luminance.

Beyond effects on attractiveness (Cash, Dawson, Davis, Bowen, & Galumbeck, 1989; Guégen, 2008; Korichi et al., 2011), cosmetics also have an influence on the perceptions of other socially relevant traits. Females wearing cosmetics are perceived to be more confident and are attributed greater earning potential than those without cosmetics (Nash, Fieldman, Hussey, Lévéque, & Pineau, 2006), as well as being more organised, sociable and popular (Graham & Jouhar, 1981). Etcoff, Stock, Haley, Vickery, and House (2011) demonstrated that varying amounts of cosmetics can differentially impact perceptions of attractiveness, as well as traits such as competence, likability and trustworthiness. The models used by Etcoff et al. (2011) were presented wearing four increasing levels of cosmetics (none, natural, professional, glamorous) as applied by a professional makeup artist. While the level of cosmetics positively increased perceptions of all four traits for a brief (250ms) exposure, after longer viewing times, only the natural and professional looks retained their positive effects on likability, and only the natural look retained its positive effects on trustworthiness. As we might expect, cosmetics can change the way a woman's face is perceived. However, studies employing a makeup artist to apply cosmetics may tell us little about how women actually use cosmetics to change these perceptions of their own face.

Furthermore, there exists within the human face an array of cues that allow observers to make accurate judgements about many aspects of personality, for example, trustworthiness (Stirrat & Perrett, 2010), dominance (Mueller & Mazur, 1997; Quist, Watkins, Smith, DeBruine, & Jones, 2011), aggression (Carré, McCormick, & Mondloch, 2009), and sociosexual orientation (Boothroyd, Cross, Gray, Coombes, & Gregson-Curtis, 2011). More generally, the static, non-expressive face by itself carries cues for several traits of the Big Five model of personality, as found both in studies using composite images (Jones, Kramer & Ward, 2012; Kramer & Ward, 2011, 2010; Little & Perrett, 2007) and individual faces (Penton-Voak, Pound, Little, & Perrett, 2006). Accurate identification of Big Five traits from the face does not seem to be related to the attractiveness "halo", in which socially desirable traits are indiscriminately assigned to attractive people, as Kramer and Ward (2010) found that the attractiveness preferences of individual observers did not affect their accuracy in identifying trait levels. These findings speak to the importance of facial cues to personality, especially given that the widely researched Big Five model reliably describes the stable biases in behaviour that vary between individuals (Connolly, Kavanagh, & Viswesvaran, 2007; Paunonen, 2003; Goldberg, 1993) and predicts real world behaviours (Paunonen & Ashton, 2001). Overall, these studies suggest individuals with similar personalities share similar facial properties and thus appearances (Jones et al., 2012). This raises an interesting question with regard to cosmetics: does a woman's use of cosmetics conceal or enhance these facial cues to personality?

Even granting the pressure to present socially desirable traits within the face, it is not clear whether cosmetics can or will create such a presentation. In other domains, personality can still be read accurately, even when there seem to be opportunities to present a more desirable self. Recent studies have identified that perceptions of our personalities are readable from the "extended phenotype" of artefacts that surround us. Our personal space, such as an office or bedroom, affords a surprising degree of accuracy when it comes to reading our Big Five personality factors (Gosling, Ko, Mannarelli, & Morris, 2002). These personality cues also extend to online social networks, but with an interesting twist - since these profiles are under volitional control, users can potentially choose what aspects of their personality they overtly display. At least in some cases, people aim to portray their idealised self (Manago, Graham, Greenfield, & Salimkhan, 2008). That is, the personality traits they would like to possess, rather than the traits they do have. However, accurate perceptions are still possible in this context. For example, Back et al. (2010) obtained objective measures of both actual and ideal Big Five personality traits for individuals, and collected ratings of their personality from their social networking site profiles. Correlating these ratings with both actual and ideal self reports revealed that despite the opportunity for displaying an ideal self, the ratings reflected the users' actual personality. Additionally, Vazire and Gosling (2004) demonstrated accurate perceptions of Big Five personality traits from an individuals' personal website. However, some perceptions here were shifted towards the ideal self, especially for the traits Agreeableness and Extraversion. While in general people portray their actual self (Back et al., 2010; Vazire & Gosling, 2004), and desire to be seen this way (Swann, Rentfrow, & Guinn, 2002), there is scope for portraying some idealised aspects of personality (Vazire & Gosling, 2004).

In the current study, we address two main questions. First, do cosmetics interfere with facial cues to personality? Second, since application of cosmetics is under volitional control, there is the opportunity for these cosmetics to send a different kind of message - women could portray their ideal selves. While studies of personality accuracy from living spaces (Gosling et al., 2002) and online social networks (Back et al., 2010) frequently find people convey their actual personality in spite of the opportunities to convey their ideal self, we predict ratings will be more tied to the ideal self when cosmetics are worn.

3.2 Method

3.2.1 Models and personality assessment

A group of 45 females (age M = 21.18, SD = 1.92) were recruited as models. Models stated their ethnicity using the UK 2011 Census form question (all self reported as white). In order to obtain measures of actual and ideal personality, we followed the same procedure as Back et al. (2010). Models completed the 20 item Mini-IPIP (IPIP: International Personality Item Pool) personality inventory (Donnellan, Oswald, Baird, & Lucas, 2006). To obtain measures of ideal personality, like Back et al. (2010), we asked models to complete an adapted version of the Mini-IPIP. Models were asked to "describe yourself as you ideally would like to be." The order of presentation for these questionnaires was counterbalanced between observers. Although not analysed here, all models also completed the SF-12 (Ware, Kosinksi & Keller, 1996) and dominance sub-scale of the IPIP (Goldberg, 1999). All models received £6 for their participation and gave full consent to having their individual pictures displayed for the experiment.

3.2.2 Defining accuracy

When discussing accuracy, we specifically refer to the correlation between observer ratings and self report measures of the Big Five provided by the models. For example, models who self report high levels of Extraversion may be rated accurately as outgoing, enthusiastic, etc. Self reports have agreement across different measures (Paunonen, 2003) and agreement with reports of acquainted others (Connolly, Kavanagh, & Viswesvaran, 2007). Moreover, self report measures have been demonstrated to predict complex real world behaviours (Paunonen, 2003; Paunonen & Ashton, 2001). Since the evidence suggests these judgements correspond to the actual level of an individual's personality, we consider self report measures suitable for assessing the accuracy of judgements of faces.

3.2.3 Photographic capture, cosmetics application and stimuli construction

Models were asked to tie their hair back from their face as much as possible, and remove all jewellery. Each model was instructed to retain a neutral expression in each photograph. Photographs were taken using a Nikon D3000 digital camera, at a distance of one metre against a plain white background. Lighting was standardised for all photographs. Models were asked, once the questionnaires were completed, to remove all traces of cosmetics before being photographed three times with a neutral expression, facing the camera. Following this, models were presented with a complete range of best-selling cosmetics, which had several colours of popular cosmetic choices. There were ten varieties of lipstick and eyeshadows, five varieties of lipgloss, four different foundation colours and two mascara colours. Models were given specific instructions to “apply cosmetics as though you were going on a night out” (similar to Russell, 2009). Following this application, models were photographed a further three times. The photographs of each model in each condition were subsequently examined by four judges to obtain the most neutral, front on photograph. Figure 1 illustrates the difference between the two conditions using composite images, though individual photographs were used in the experiment itself.

Stimuli construction. All of the selected photographs were rotated so both of the pupils lay along the same transverse plane using ImageJ (NIH, open source software), minimising postural effects in this direction. The photographs of the models were then cropped to just above the hairline, to the widest points of the face (typically the zygions), and just below the chin, as demonstrated in Figure 1.

Figure 1. Composite images of the 45 models without (left) and with (right) cosmetics. These composites, created using JPsychomorph software (Tiddeman, Burt & Perrett, 2001) indicate the typical effects of cosmetics in our sample.

3.2.4 Participants

Eighty two participants (31 males, age $M = 20.59$, $SD = 4.59$) from Bangor University took part in the study as observers in exchange for course credits.

3.2.5 Design

Two factors defined the presentation of stimuli: Cosmetic condition (Without, With) x Trait (Agreeableness, Conscientiousness, Extraversion, Neuroticism, Openness). Faces Without or With cosmetics was a between-subjects variable, with observers assigned to one of two groups which rated faces of only one cosmetic condition. Assignment was randomised (Without group n = 41, 17 males, age M = 20.15, SD = 2.60; With group n = 41, 14 males, age M = 21.02, SD = 5.96), and observers were unaware of the condition they were rating.

3.2.6 Procedure

On each trial, a face appeared in the centre of the screen (approximate image size 12 x 19 cm, 350 x 550 pixels, with a viewing distance of approximately 50cm but not fixed). Observers were asked to rate each face on a scale from one (very low) to seven (very high). This scale appeared below the faces, and the statement they rated the face on appeared above the face. Observers indicated their response by clicking on a number in the scale with an unspeeded mouse click. If an observer recognised an individual, they clicked a 'recognise' option. Data for that model was then removed for that observer, across all traits.

For each of the Big Five personality traits, statements were adapted from the Mini IPIP questionnaire and featured statements reflecting high social desirability. The order each trait appeared in was randomised, as was the order each face appeared within each block, for a total of 225 trials. Trials were blocked by trait, and observers rated each face for all five traits. We exclude one model from our analyses due to unusual green hair colour which could not be entirely cropped from the image, and which may have affected observer perceptions (final sample n = 44, age M = 21.18, SD = 1.94). We also reverse score Neuroticism ratings and self reports to Emotional Stability.

3.3 Results

3.3.1 Preliminaries

For both Without and With cosmetic conditions, there was high inter-rater agreement for all five judgements of personality (Cronbach's α ranged from .84 to .92). Similar to previous research (Back et al., 2010; Kramer & Ward, 2012; Saxton, Caryl, & Roberts, 2006), we focus our analyses on the accuracy of individual observers. For example, consider two observers rating four faces on a particular trait. If they agree on two faces, assigning the same rating, but diverge widely on the others, then averaging their ratings and correlating these with personality ratings would lead to an overestimation. We could claim that on average, people can accurately read personality information in the face. We could not claim that this ability occurs at the individual level, or examine whether some individuals are more influenced by facial cosmetics, for example (see Monin & Oppenheimer, 2005, for a detailed review of this method). We calculated accuracy for each observer by correlating their ratings of all models on a given trait with the models' self reported levels of the same trait, for both actual and ideal personality, separately. These correlations were then were transformed using Fisher's *r*-to-*z* transform. Subsequently, these *z* values were aggregated to give an average correlation (i.e., accuracy) for that particular trait. For each observer, there were ten correlations for Big Five traits. Half of these correlations, given our design, were for actual personality traits, while the other half were for ideal traits. We then tested accuracy by comparing the distribution of these values for each of the traits to zero.

A benchmark for interpretation. For the following analyses, the size of the mean correlation for each trait in each condition is generally small in absolute terms when compared to studies of personality accuracy from full body, posed photographs (Naumann, Vazire, Rentfrow, & Gosling, 2009) and online profiles (Back et al., 2010). However, several things need to be considered. First, we have deliberately minimised the available cues. Other studies typically have a wealth of information available such as clothing, facial expressions, a multitude of photographs from different social events, posture and biographical information (Back et al., 2010; Naumann et al., 2009). Given the relative paucity of our stimuli - a tightly cropped photograph of a face with a neutral expression - a decrease in accuracy would be unsurprising. Second, compared to other studies examining accuracy using individual faces (specifically Penton-Voak et al., 2006), the sizes of the results are comparable. A meta-analysis of interpersonal perception experiments found a mean accuracy correlation of around .15 to be normal for zero-acquaintance studies, although cues such as clothing were available (Kenny, 1994).

3.3.2 Actual and ideal traits and absolute differences in perceptions

Since our results are based upon self reports of both actual and ideal measures of personality, we first discuss the differences and relationships between these, before examining the ratings of conditions. Differences between actual and ideal traits are summarised in Table 1. For our sample of models, self reports of ideal personality across all Big Five traits were significantly higher than those of their self reported actual personality, all *p*s $< .002$. Additionally, all actual and ideal reports were significantly correlated, all *r*s(43) > .55, $p < .004$, except for Emotional Stability (ES). This suggests that models wanted to be, on average, somewhat higher than their current level of a trait for four of the Big Five. For the case of ES, we found that models with higher than average scores showed the usual pattern of wanting to be somewhat higher than their current level, $r = .24$; however, for models with lower than average ES scores, the trend was not present. These models typically reported their ideal self as being very high in Emotional Stability, $r = -.34$. These correlations were non significant, but suggestive. However, in general, these results confirm others showing good agreement on the direction of ideal personality traits, especially Extraversion and Agreeableness (Vazire & Gosling, 2004).

Comparing the mean rating of each model between cosmetic conditions yielded no perceptual differences between traits, all *p*s > .05, which suggests cosmetics do not affect perceptions of personality at the group level.

Table 1. Means, standard deviations, and correlations between actual and ideal traits

Trait	Actual	Ideal	*r*
Agreeableness	4.11 (0.59)	4.38 (0.58)	.43**
Conscientiousness	3.4 (0.87)	4.26 (0.64)	.40**
Extraversion	3.17 (0.87)	3.94 (0.72)	.50**
Emotional Stability	3.15 (0.72)	4.13 (0.72)	.06
Openness	3.78 (0.74)	4.23 (0.62)	.55**

Note. Numbers in parentheses denote standard deviations, $^{**}p < .001$.

3.3.3 Cosmetics and trait accuracy: Can cosmetics influence accurate judgements of personality?

Our first key test is whether women use cosmetics in a way that changes how accurately their personalities can be read. One hypothesis is that because women use cosmetics to make themselves appear more socially desirable, cosmetics may interfere with reading personality traits from the face. For example, cosmetics may allow women to mask any socially undesirable traits and exaggerate any socially desirable ones. A simple test of this hypothesis is to compare accuracy in identifying actual personality traits between cosmetics conditions. As illustrated in Figure 2, the general pattern of identification accuracy is similar. In the Without condition, observers were significantly better than chance in identifying three of the Big Five: Extraversion, $t(40) = 2.32$, $p = .025$; Emotional Stability, $t(40) = 5.27$, $p < .0001$; and Openness, $t(40) = 6.89$, $p < .0001$. Accuracy for these traits was largely preserved in the With condition, as observers could still accurately identify Emotional Stability, $t(40) = 6.89$, $p < .0001$; and Openness, $t(40) = 2.92$, $p = .006$, although Extraversion was not significantly different from chance, $t(40) = 1.55$, $p = .13$. However, there was no significant difference in accuracy between cosmetics conditions for any of the traits, all *p*s > .36. Therefore, not only can personality traits be accurately read from the face, these results show that accurate reading can occur even within a group of women who have applied their own cosmetics. For example, in a group of women who are all wearing cosmetics, a woman who is identified as low in Openness will also be identified as low in Openness when in the context of a group of women who are not wearing any cosmetics. Additionally, when correlating the mean ratings of each model in both cosmetics conditions, ratings of each trait were significantly correlated, all *r*s > .55, all *p*s < .001.

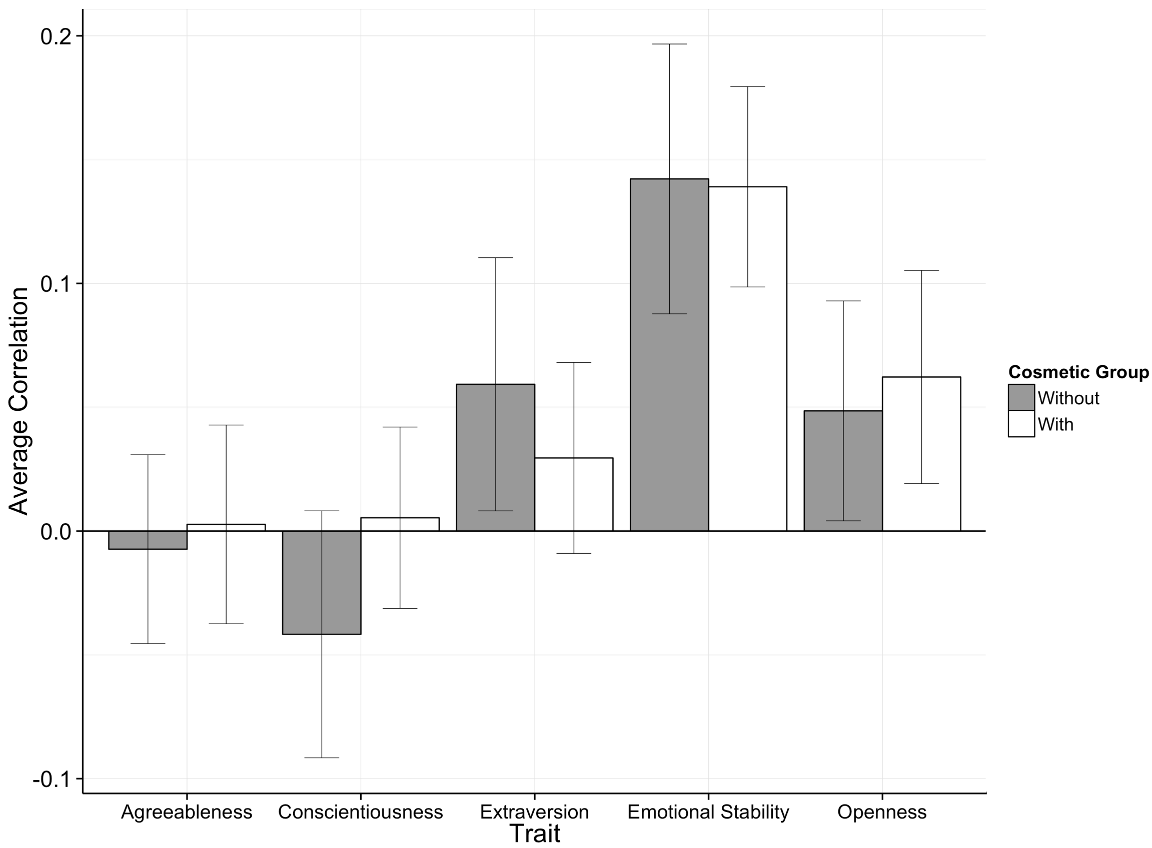

Figure 2. Accuracy for actual personality traits across both cosmetics conditions. Error bars represent a 95% confidence interval. Conditions with error bars crossing the zero line are not significantly different from chance.

Are cosmetics deceptive? Our second aim was to investigate whether cosmetics can function as a deceptive cue. Although the above analysis finds little effect of cosmetics on the correlation of actual trait levels and observer ratings, this does not necessarily mean that cosmetics are not influencing observers. This is a particular issue given the generally high correlations between actual and ideal self we reported earlier. If women wish to be somewhat more socially desirable than they actually are (see Table 1), and use cosmetics to do so, then the correlation of personality ratings to actual trait levels might be roughly similar in a group with and without cosmetics (as we found above). Nevertheless, the group with cosmetics may appear more like their ideal selves. To test the possibility that cosmetics could be used to move observer perceptions toward the ideal self, we performed partial correlations between the ratings of women in the With condition and their self reported ideal personality, controlling for self reports of actual personality. These correlations were then transformed into Fisher's *z* scores, averaged, and then transformed back.

When using cosmetics, ideal levels of Extraversion influenced observer ratings when controlling for the effects of actual Extraversion, $t(40) = 3.86$, $p < .0001$. This was also true for Openness, $t(40) = 3.43$, $p = .001$. These partial correlations indicate, for example, that if two women wearing cosmetics were equally extraverted, the one with the higher ideal level would be perceived to be more extraverted. That is, it appears that women are using cosmetics to move their appearance towards their ideal levels of Extraversion and Openness. Surprisingly, individuals perceived models in the opposite direction to how Conscientious they would like to be, $t(40) = -2.44$, $p = .019$. So, if two women wearing cosmetics are equally conscientious, the one with the higher ideal level would be perceived as less conscientious. There was however a marginally significant partial correlation for Emotional Stability in the Without condition, $t(40) = 2.11$, $p = .04$, which may have been due to postural effects (Jones et al., 2012), but is not pursued further.

Taken together, our results show how women's use of cosmetics affects an observers perception of personality. First, it is interesting to see that some personality traits can be accurately estimated simply from non-expressive facial photographs of women with and without cosmetics. Second, although overall accuracy is similar for the two conditions, we also find that for some traits, women can use cosmetics to bias perceptions towards their ideal selves.

3.4 Discussion

Previous studies have demonstrated accurate detection of personality traits from neutral faces (Jones et al., 2012; Kramer & Ward, 2010; Little & Perrett, 2007; Penton-Voak et al., 2006). Here, we examine novel questions regarding these perceptions and the use of cosmetics. First, our results demonstrated that overall, relative accuracy in identifying personality traits from the face was affected by women applying their own cosmetics. However, for some traits we found that cosmetics allowed women to bias perceptions towards an idealised version of themselves.

At first glance, these two findings may seem to conflict with one another. Personality accuracy was not much affected by the application of cosmetics, but cosmetics did shift observers perceptions of some traits towards the ideal self. It seems that the use of cosmetics by women can therefore increase the perceived level of socially desirable traits without affecting the *relative* strength of personality cues present in the face. As an example, the perceived relative Openness levels within a group of women will be much the same whether or not the group is wearing cosmetics. However, women within a group wearing cosmetics would be perceived as being closer to their ideal level of Openness. This may be due to cosmetics working on biological bases of beauty (Korichi et al, 2011; Samson et al., 2010), thus making an individual appear more socially desirable; or it may be through an association of cosmetics with pride in appearance. It is also important to note our results extend to the relativity of cosmetic use; if women are wearing cosmetics then those who strive to be more socially desirable will appear to be more so. Studies implementing within subjects designs, with each observer rating an model with and without cosmetics have demonstrated than more socially desirable traits are attributed to those wearing cosmetics (Etcoff et al., 2011;

Mulhern, Fieldman, Hussey, Lévêque, & Pineau, 2003), and we would predict a similar result here.

Although the women in our sample were able to use cosmetics effectively to bias observers to perceive aspects of their ideal selves, this may have come at some cost, as it appeared that cosmetics also acted to conceal ideal levels of Conscientiousness. A possibility might be that women with the highest levels of ideal Conscientiousness, relative to their actual levels, were using more cosmetics, perhaps in line with the task instructions to apply cosmetics as if they were going on a night out. Some evidence has shown individuals are biased to perceive high cosmetic use as having an association with low levels of task-based competency (Cox & Glick, 1989), and this may have produced the observed effect with Conscientiousness.

Compared to previous experiments involving cosmetics, the present study uses several novel methods. First, experiments involving cosmetics typically have a makeup artist applying the cosmetics (Cox & Glick, 1986; Etcoff et al., 2011; Mulhern et al., 2003; Nash et al., 2006). While this offers a level of standardisation between models, it does not offer insight into how individuals can manipulate their own facial cues. Of course, if our models were allowed to wear their own cosmetics, there was the possibility that some individuals would use highly idiosyncratic or unconventional shades, or employ other cosmetic devices such as fake eyelashes. We attempt a compromise by utilising a range of best selling, popular items that all models used, and then assessing how cosmetic use within these broad constraints changed perceptions. Second, other studies involving rating faces on social traits (Etcoff et al., 2011; Mulhern et al., 2003) use a within-subjects design. Observers see each model in different cosmetics conditions, and, with a small number of models (Etcoff et al., 2011), observers are comparing faces with cosmetics to those without. Our between-subject design allowed us to observe that, although the use of cosmetics biased perceptions of some traits towards women's ideals, it did not greatly change the ranking of perceived trait levels relative to other women wearing cosmetics.

Few studies have examined the accuracy of personality judgements from neutral, static photographs of individual faces, rather than composite images (Penton-Voak et al., 2006; Shevlin, Walker, Davies, Banyard, & Lewis, 2003). While these studies used different constructs of personality from each other, both found evidence of accurate detection of the respective traits. Shevlin et al. (2003) demonstrated unambiguous accuracy of Psychoticism (Eysenck, 1994) from the face, through tightly cropped photographs. Penton-Voak et al. (2006) found accuracy for Extraversion, Emotional Stability and Openness in male faces, but only Extraversion in female faces, though clothing, cosmetics and hairstyle may have been present in the stimuli. Our results further suggest that personality is readable from a static, non expressive individual face.

In conclusion, although cosmetics may give women the opportunity to completely disguise or conceal cues to their true personalities, our results show they do not typically use them in this way. However, women can use cosmetics to exaggerate observer perceptions, so that for some traits, the women are seen more as they would ideally like to be, rather than actually are.

The next step

The findings in this chapter are essentially a null result, demonstrating little change in accuracy after cosmetics are applied. In the next chapter, I investigated how cosmetics change perceptions of social traits, as well as attractiveness, and how this differs between the sexes. I also extended this across different age groups to further examine sex by cosmetics interactions.

CHAPTER 4: He's not that into you: Facial cosmetics do not reflect men's preferences

Abstract

Who do women impress by wearing cosmetics? Conventional accounts suggest women use cosmetics to embody desirable facial attributes, making themselves more attractive to mates. But, it is unknown how observers of either sex respond to cosmetic use. Photographs of models with and without cosmetics were rated by separate groups of observers on several social traits. Surprisingly, large interactions were found between the sex of the observer and cosmetics - women found models more socially desirable with cosmetics, while men showed the opposite pattern. When observers manipulated the amount of cosmetics to reflect their own preferences, women applied more cosmetics than males for Femininity, though both sexes agreed on Health. However, the actual amount of cosmetics worn by models was significantly greater than observers' optimal amounts. We speculate that cosmetic use may serve as a mode of female intrasexual competition, and that cosmetics use challenges the universal agreement of an attractive female face.

4.1 Introduction

Cosmetics are used widely across most cultures (Jablonski, 2006), and the majority of users in contemporary Western cultures are women (Campbell, 2004) What are women achieving through this highly personal form of body decoration? Cosmetics can enhance some of the factors important for women's facial attractiveness, such as perceived health via a smoother skin texture (Samson, Fink, & Matts, 2010); by emulating a youthful appearance by making eyes and lips appear larger using mascara and lipstick (Mulhern et al., 2003), and through increasing perceived symmetry (Korichi et al., 2011).

More generally, cosmetics can increase apparent sexual dimorphism and perceptions of femininity. Russell (2003) demonstrated that women have greater contrast between facial features (mouth and eyes) and their bare skin than do men, and that exaggeration of this contrast via cosmetics increased perceptions of femininity (Russell, 2009). In women's faces, feminine traits are strongly associated with attractiveness (Rhodes, 2006), as demonstrated by a variety of different lines of evidence. Across cultures, feminine facial features such as a small chin, large eyes and high cheekbones are found to be attractive in women (Cunningham, 1986; Etcoff, 1999). Similarly, manipulations of feminine traits of women's faces leads to increases in attractiveness (Russell, 2003). Concordantly, the creation of an attractive female face results in a face with very feminine features (Johnston & Franklin, 1993). Additionally, the time taken to classify a face as female is predicted equally well by its rated attractiveness or femininity, suggesting these traits refer to the same or similar constructs (O'Toole et al., 1998).

But surprisingly, especially given the extremely widespread use of cosmetics and research on perceptual effects, there remains a basic question unanswered: who do women most impress through their use of cosmetics? According to both popular and scholarly sources (Buss, 1988), cosmetics help women to attract a mate. If this is the case, we might predict men to respond more favourably to women's cosmetics than would other women, who may act negatively towards attractive others (Fisher, 2004; Luxen & Van de Vijver, 2006). Alternatively, men and women might respond to cosmetics in a similar way. There is a large body of literature, based upon faces without cosmetics, that has demonstrated that observers of different sex (Johnston & Franklin, 1993), culture (Cunningham et al., 1995), age (e.g., infant or adult: Langlois et al., 1991), and sociosexual orientation (Boothroyd et al., 2008) agree on what constitutes an attractive, feminine face.

A final hypothesis is that women may use cosmetics not so much to attract men, but to impress other women. Women compete strongly in the realm of appearance (Campbell, 2004), and care more about other women's perceptions of their attractiveness than men's (Graziano et al., 1993). A consistent body of literature has demonstrated that style of dress is a prominent avenue of female competition (Durante, Li, & Haselton, 2008). Additionally, women are particularly sensitive to the physical appearance of other women, perceiving attractive women as more socially dominant (Dijkstra & Buunk, 2001), and report greater distress when potential rivals surpass them in attractiveness (Buss et al., 2000). Given that cosmetics and clothing often are often employed together as a method of improving appearance (Singh, 2004), it is possible that cosmetics may be used for competitive behaviours, with women being sensitive to the perceptual effects of cosmetics.

To investigate the effects of cosmetics on perceptions of men and women observers, we photographed young women without and with cosmetics, applied for "a night out". As cosmetics influence not only perceptions of femininity, but also many social traits (Etcoff, et al., 2011), we collected ratings of personality traits (Jones, Kramer, & Ward, 2012), dominance (Dijkstra & Buunk, 2001), competence (Etcoff et al., 2011) and health, which is linked with femininity and overall attractiveness (Gray & Boothroyd, 2012). Importantly, such traits have shown agreement between sexes in previous work.

4.2 Method

4.2.1 Models

Forty-five women (age $M = 21.18$, $SD = 1.92$) were recruited as models. All were Bangor University students, who self-reported as White ethnicity. Models gave full consent for their photographs to be used and were paid £6 for participation.

Stimuli creation. On arrival, models removed any facial cosmetics and jewellery they were wearing, and tied their hair back from their face as much as possible. They were then photographed three times (with no cosmetics, the None condition). A range of best-selling lipsticks, mascaras, blushers, and foundations were provided in a variety of different shades, and models were asked to apply cosmetics "as though you were going on a night out". After application, models were photographed a further three times (Night Out condition).

Photographs were taken against a white background with a Nikon D3000 camera, at a distance of approximately one metre. Lighting was standardised using a flash, angled 45° toward the ceiling. Models were instructed to maintain a neutral expression for all photographs.

Each photograph was later examined and the most neutral, front on photograph was chosen for each condition. The selected images were rotated so that the pupils were aligned along the transverse plane, to minimise any postural differences along this axis. Photographs were cropped to frame above the hairline, the widest point of the face, and just below the chin. The application of cosmetics was not unusual, in that it was mostly concentrated around the eyes and mouth. Figure 1 illustrates both the typical use of cosmetics and the general form of the stimuli used.

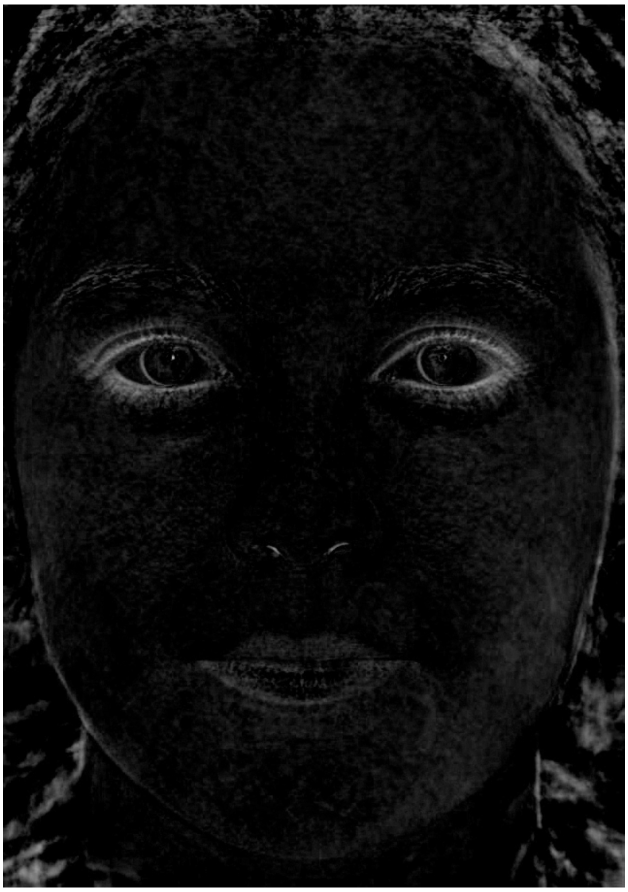

Figure 1. A difference image between the average cosmetics and no cosmetics images. Regions in black were identical in both images, while increasingly light regions indicate larger differences. Note the larger differences around the eyes and mouth, indicating a typical application (Russell, 2010). This figure also illustrates the general form of the face stimuli. Within the study, only individual faces were used.

4.3 Experiment 1

4.3.1 Observers

Seventy-two observers (age *M* = 20.48, *SD* = 4.41; 36 men) from Bangor University participated for course credit.

4.3.2 Procedure

All models were rated with and without cosmetics, on nine traits: Agreeableness, Conscientiousness, Extraversion, Neuroticism, Openness, Femininity, Health, Dominance, and Competence. On each trial, a face appeared centrally on the screen (350 x 550 pixels, approximately 9 x 13.5 cm), on which observers rated from one (very low) to seven (very high) on the current trait, defined for each block by a description appearing above the face. Observers made unspeeded responses by clicking with the mouse on a number in the scale. If an observer was familiar with a model, they clicked a ‘recognise’ button that removed data for that model from the session (removing 2% of trials). When rating actors on the Big Five personality traits, statements were adapted from the Mini-IPIP questionnaire (IPIP: International Personality Item Pool; Donnellan, Oswald, Baird, & Lucas, 2006), and featured statements high in social desirability. For example, when rating Extraversion, participants saw “How Extraverted is this person? e.g. is more talkative, more enthusiastic, more assertive, more outgoing and sociable.” When rating health, statements contributing the most to the physical health component of the 12-Item Short Form Survey (SF-12; Ware, Kosinksi, & Keller, 1996) were used. When rating Dominance, four statements from the 11-item dominance subscale of the IPIP were used (Goldberg, 1999). Participants saw “How Dominant is this person? e.g. quick to correct others, tries to outdo others, challenge others’ point of view, put people under pressure.” Finally, when rating faces for Femininity and Competence, participants saw “How feminine is this person? e.g. has more facial qualities associated with women,” and “How competent is this person? e.g. appears to be able to do things more efficiently and successfully,” respectively.

Cosmetics presentation was manipulated between-observers, so that each model was rated by a group of separate observers in the None (age $M = 20.25$, $SD = 2.74$) and Night Out (age $M = 20.77$, $SD = 5.11$) conditions. Equal numbers of men and women rated each condition. Previous studies have tended to use a within-observer design, so that observers see each model with and without cosmetics in a short space of time (Etcoff et al., 2011). The within-observer design may emphasise the changes in appearance due to cosmetics, and so may be more likely to tap into values and beliefs about cosmetic use in comparison to the between-observer design used here. Observers rated each of the models on all nine traits for a single cosmetics condition. The 405 trials were blocked by trait, with trait order randomised between observers, and models randomly ordered within each block.

4.3.3 Results and Discussion

We excluded one model (final sample $n = 44$, age $M = 21.18$, $SD = 1.94$) due to a dyed hair colour that could not be fully cropped from the image. However, this had no effect on the pattern of significant findings. We reverse-scored ratings of Neuroticism to represent Emotional Stability, so that personality traits were more socially desirable as they increased. For each model in each condition, we calculated the mean observer rating, and examined these differences using a 2 (Cosmetics: None, Night Out) x 2 (Observer Sex: Women, Men) ANOVA for each of the nine traits separately.

Our main finding was that across all but one of the investigated traits, cosmetics led to more favourable perceptions for female observers than male observers. This consistent finding is illustrated in Table 1, where eight of the nine traits display a significant Cosmetics x Sex interaction, with the exception being Extraversion. In all of these cases, the difference between the Night Out and None conditions was more positive for women than for men.

Across the eight traits shown in Table 1, there were also consistent main effects of Sex, whereby male observers rated, in general, lower than female observers, all F's > 5.44, all ps < .025. This pattern has been observed several times before (Cross & Cross, 1971; Furnham, Mistry, & McClelland, 2004), and it seems that where sex differences are evident in facial ratings it is typically in this direction (Foos & Clark, 2011). The one exception was Dominance, $F(1, 43) = 12.61$, $p = .001$, where men rated higher than women.

Overall, cosmetics produced marked and systematic differences in the perceptions of men and women. The differences in mean ratings for women and men observers suggest cosmetics led to more favourable perceptions by women, for appearances of Femininity, Health, Dominance, Competence, and four of the Big Five personality factors: Agreeableness, Conscientiousness, Emotional Stability, and Openness.

Finally, for Conscientiousness, there was a main effect of Cosmetics, $F(1, 43) = 5.90$, $p = .02$, indicating models appear generally more Conscientious without cosmetics than with. This suggests that overall cosmetics have a negative impact on perceptions of Conscientiousness. Indeed, Cox and Glick (1986) demonstrated that cosmetics had negative effects on the expected performance of female job applicants. Wearing more cosmetics made a woman appear as though she was unlikely to be reliable or hard working, which are facets of Conscientiousness (Goldberg, 1999). There were no main effects of Cosmetics for any other traits.

Table 1. Means, standard deviations, and Sex x Cosmetics *F*-ratios for all traits.

Trait	Sex	None	Night Out	Schematic of Cosmetics * Sex interaction	Cosmetics * Sex Interaction *F* (1,43)
Agreeableness	Female	4.00 (0.78)	4.28 (1.06)		14.67^{***}
	Male	4.03 (0.64)	3.98 (0.84)		
Conscientiousness	Female	4.45(0.66)	4.43 (0.74)		4.42^{*}
	Male	4.35 (0.55)	4.09 (0.81)		
Extraversion	Female	3.89 (0.80)	4.08 (0.79)		1.51
	Male	3.93 (0.68)	3.97 (0.81)		
Emotional Stability	Female	4.15 (0.52)	4.26 (0.69)		15.52^{***}
	Male	4.21 (0.61)	3.94 (0.79)		
Openness	Female	3.96 (0.67)	4.15 (0.76)		24.58^{***}
	Male	4.03 (0.66)	3.74 (0.85)		
Health	Female	4.14 (0.88)	4.40 (0.98)		60.73^{***}
	Male	4.18 (0.84)	3.92 (1.01)		
Dominance	Female	3.61 (0.82)	3.97 (0.92)		33.47^{***}
	Male	4.10 (0.74)	3.86 (0.74)		
Femininity	Female	3.86 (0.84)	4.15 (0.98)		37.31^{***}
	Male	3.92 (0.84)	3.73 (1.00)		
Competence	Female	4.27 (0.58)	4.35 (0.79)		6.85^{*}
	Male	4.23 (0.61)	4.08 (0.78)		

Note. Numbers in parentheses denote standard deviations. The form of the Cosmetics*Sex interaction is indicated by schematics; the blue line indicates male observer ratings, the pink line, females. Ratings in the None condition on the left side of the horizontal axis, Night Out on the right. The scale of the vertical axis is constant across all traits. Significance values of *F*-ratios: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

4.4 Experiment 2

The results of Experiment 1 suggest men and women respond very differently to cosmetics. The higher ratings afford by women raters to faces with cosmetics is suggestive of cosmetics being used to impress other women more than for attracting a mate. Indeed, men rated faces without any cosmetics as more socially desirable. To further investigate these sex differences, we asked observers to digitally manipulate the amount of cosmetics worn by the models in order to optimise the two traits that showed the largest interactions from Experiment 1: Femininity and Health. This methodology also allowed us to investigate whether the amount of cosmetics worn by models is either excessive, or too minimal.

4.4.1 Observers

Forty observers (age $M = 20.42$, $SD = 2.34$; 20 males) received course credit for participation.

4.4.2 Stimuli Sequences

The None and Night Out images for the 44 models analysed in Experiment 1 were landmarked using JPsychomorph (Tiddeman, Burt, & Perrett, 2001). A sequence of images was then created for each model, along the gradient defined by the differences between the None (defined as 0%) and Night Out image (100%) of that model. The sequence was extended past the anchors, from -50% (exaggerated effects of not wearing cosmetics) to 150% (exaggerated effects of wearing cosmetics), for a final sequence of 21 images of 10% increments between -50% and 150%. Each model appeared to gain incremental amounts of cosmetics from their None to Night Out images, with exaggerations of each either side.

4.4.3 Procedure

Each trial began with a random image from a models' sequence. Underneath the face was a circle with bar through a random point of the circumference. The bar was moved around the circumference with the left and right response keys. Each position of the bar corresponded to a face in the model's image sequence: moving the bar around the circle changed the facial appearance, moving smoothly through the sequence and back again. The starting position of the bar and the image corresponding to this position were randomised for every trial. In separate counterbalanced blocks, observers selected the image they perceived as the most feminine or healthy-looking face, moving through the sequence and then indicating their choice with the spacebar. Observers were not told that use of cosmetics was being manipulated across the image sequence. Model sequences appeared once in each block, in a random order. An example trial is displayed in Figure 2.

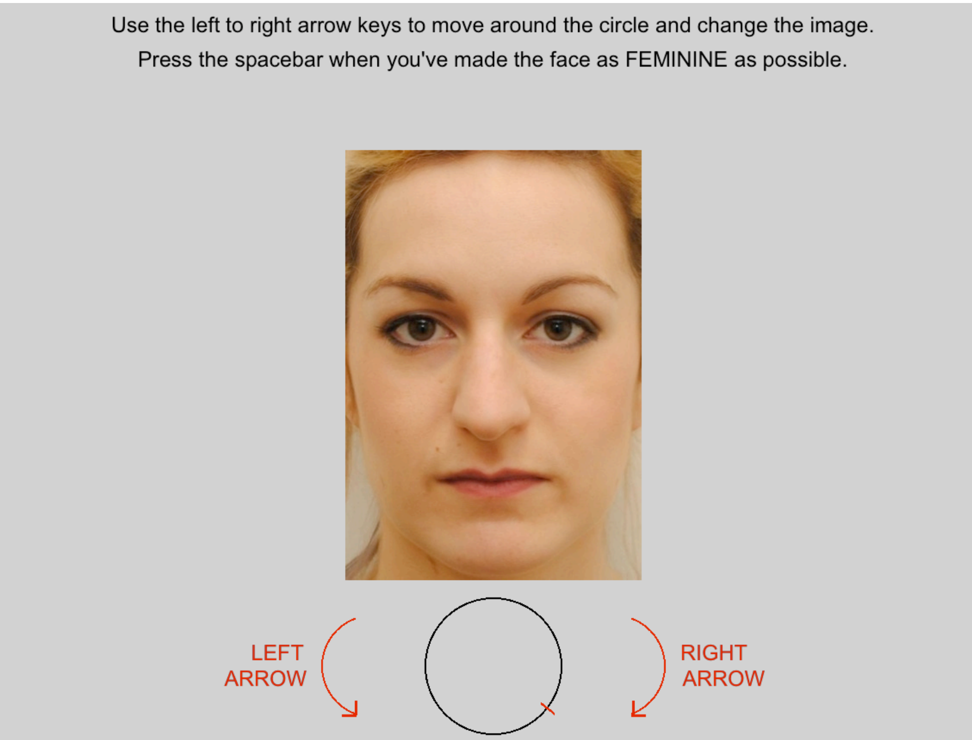

Figure 2. An example of a trial from the Femininity block of Experiment 2.

4.5 Results

For each model, we calculated the average level of cosmetic use for optimal perceptions of Femininity and Health in percentages, as indicated by male and female observers. These results are shown in Figure 3. Both the relative and absolute measures of preference are interesting. A 2 (Trait: Femininity, Health) x 2 (Observer Sex: Female, Male) ANOVA revealed a main effect of Trait, $F(1, 43) = 104.15$, $p < .0001$, indicating more cosmetics are required for optimal perceptions of Femininity, $M = 79.35$, than Health, $M = 56.42$. Additionally, a main effect of Sex revealed that female observers chose higher amounts of cosmetics, $M = 68.56$, than males, $M = 60.84$, $F(1, 43) = 33.61$, $p < .0001$, mirroring the results of Experiment 1. Finally, there was a Trait x Sex interaction, $F(1, 43) = 23.16$, $p < .0001$. Female observers chose higher levels of cosmetics than did males when judging models' Femininity, $t(43) = 8.14$, $p < .0001$, while judgements seemed to be in relative agreement between the sexes for Health $t(43) = 1.51$, $p = .14$. These results contrast with the differences apparent in Experiment 1, where cosmetics were either wholly present or absent (see Table 1).

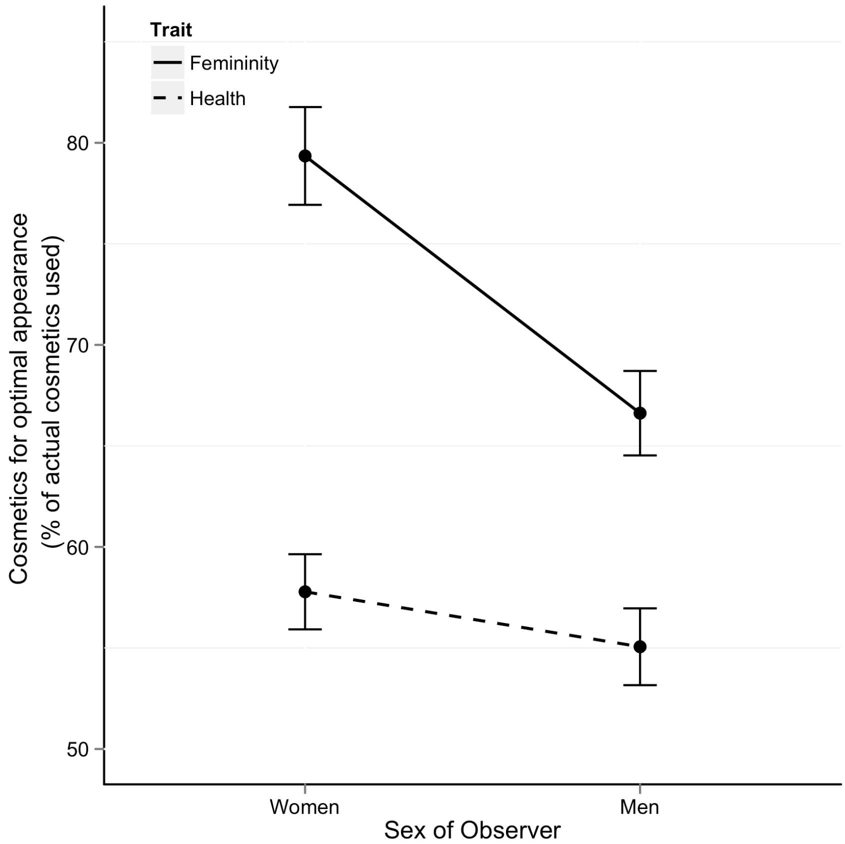

Figure 3. Observer preferences for the level of cosmetics required for an optimally feminine or healthy appearance, expressed as a percentage of actual cosmetic use. Error bars represent one standard error.

Models' use of cosmetics served to improve their appearance, in that the preferences of men and women for optimal Femininity and Health were significantly above 0% (i.e., as the models appeared in the None condition), all *t*s(43) > 28.92, *p*s < .0001, Bonferroni corrected, suggesting neither sex preferred a purely "natural" look. However, overall, the models wore too much makeup for observer preferences. Mean preferences for both Femininity and Health were well below the 100% level (i.e., what models applied to themselves in the Night Out condition), for both male and female observers, all *t*s(43) > 8.55, *p*s < .0001, Bonferroni corrected. Indeed, for an optimally healthy appearance, cosmetic use would need to be reduced by almost 50% (Figure 3).

To further explore the obtained results for Femininity, we examined the similarities differences in men and women's preferences of the trait, for all models, illustrated in Figure 4. Two of the models used levels of cosmetics which male observers found optimally feminine, while the rest used more than was preferred by men. A relatively small number of models seem to have tuned their use of cosmetics to produce an appearance that is optimally feminine to men. We checked to see whether the women who were applying cosmetics so as to achieve near optimum femininity differed in their baseline levels of femininity. For example, perhaps the most feminine model without makeup applied a different amount of cosmetics to the least feminine. However, there was no correlation between ratings of Femininity without cosmetics (from Experiment 1) and the level of cosmetics for optimal Femininity (from Experiment 2), either for women, $r(42) = -.12$, $p > .05$, or men, $r(42) = -.07$, $p > .05$.

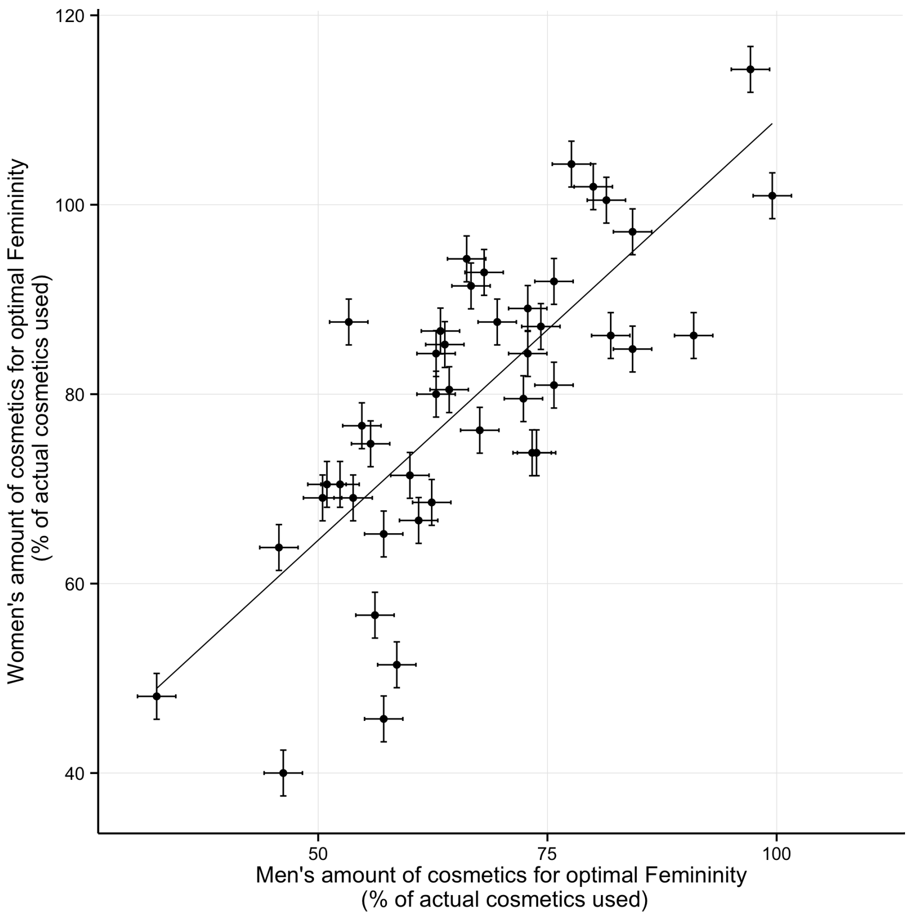

Figure 4. Mean choices of models for Femininity, across men and women observers. Percentages indicate amount of cosmetics applied. Vertical error bars represent one standard error of female observers, while horizontal error bars represent one standard error of male observers.

4.6 Discussion

We found that facial cosmetics affected men and women differently. In Experiment 1, for a wide range of social traits, women valued cosmetics more than men. In Experiment 2, we found that the level of cosmetics resulting in optimal appearances of femininity was significantly greater for women than men, which again suggested models were impressing women more than with their use of cosmetics. However, both sexes agreed on what constituted an optimally healthy appearance. The most consistent finding here however, was that models used an excess of cosmetics, beyond any perceptual benefits. The results suggest increasing perceptions of attractive facial traits would, on average, require a reduction of approximately half the applied cosmetics. However, cosmetics did significantly improve appearance above wearing none at all.

If the conventional account is correct (Buss, 1988), and women use cosmetics to attract a mate by embodying desirable facial attributes (Cunningham, 1986), then our results demonstrate our models are failing. But, if females are wearing cosmetics to impress or compete with other females, then they are more successful. We suggest the sex difference we find between observers is consistent with cosmetics as a form of intrasexual competition (Durante et al., 2011). In other domains, women are particularly sensitive to the physical attractiveness of other women. For example, jealousy is evoked more strongly in women when viewing a potential rival with a low waist-to-hip ratio (Singh, 1993). Women also perceive other women with low waist-to-hip ratios as more socially dominant (Dijkstra & Buunk, 2001), which is echoed in the results of Experiment 1 with cosmetics.

For both femininity and health, models wore a significant excess of cosmetics, especially for men's perceptions of femininity. If females are competing directly with other females, there is the possibility that competitive behaviours will drive a feature beyond the preferences of males. Consider the desire for thinness amongst women in Western cultures, where it is a signal of youth and fertility (Mealey, 2000), and exposure to thin rivals invokes feelings of dissatisfaction regardless of their facial attractiveness (Li, et al., 2010). One hypothesis is that eating disorders such as anorexia may be partially driven by intrasexual competition, as the abundance of thin competitors causes women to adopt appearancefocused behaviours (e.g., Faer et al., 2005; but see Fairburn, Cooper, Doll, & Welch, 1999, for a dissenting view). As men traditionally prefer fuller figures (Fallon & Rozin, 1985), the origins of women's desires for thinness are not driven by men's preferences, but may originate from female competition (Campbell, 2004). Our results indicate that women are not wearing cosmetics to attract a mate, but to compete with other women. The fact men show a preference for faces with less cosmetics is suggestive of such competition. A recent study has highlighted that in times of economic hardship, the amount of money spent by women on cosmetics increases significantly (Hill et al., 2012). It is possible that in such times female competition for mates with resources drives this spending behaviour, given the nature of our results.

Our sample of models applied cosmetics themselves, so our results reflect an "ecologically valid" use of cosmetics, rather than what might be achieved, for example, by a professional makeup artist (Etcoff et al., 2011). But as demonstrated in Figure 1, there was nothing particularly remarkable about how our sample of models used cosmetics, conforming closely to the "received style" described by Russell (2010), with application of eye and lip cosmetics increasing the contrast between feature and skin luminance. We therefore consider our models to be reasonably typical in terms of cosmetic application.

Although women may well consciously intend to attract mates by using cosmetics, some other factor, such as a competitive drive with other women, seems to move this behaviour beyond the preferences of men. However, speculations about intrasexual competition aside, our study addresses a basic issue at the heart of an extremely widespread behaviour. Agreement between the sexes on social desirability, established for women's faces without cosmetics, does not extend to faces with cosmetics.

4.7 Experiment 3

The results of Experiment 1 demonstrate that men and women respond differently to cosmetics, and indicates the possibility that cosmetics may be used by women to impress other women. We predicted that cosmetics may act as a form of intrasexual competition, as women compete in the realm of appearance (Campbell, 2004). Such a prediction places cosmetics use squarely in the domain of mate choice. However, cosmetics are used by females across the lifespan, and can function to make an individual look younger by acting on areas of age-reduced contrast (Porcheron, Mauger, & Russell, 2013). Given that youthfulness is an important cue to mate choice (Mulhern et al., 2003), and that skin colour plays an important role in age perception (Fink, Grammer, & Matts, 2006), it seems likely that older women may use cosmetics in a similar fashion to younger women. If so, how do older men and women respond to cosmetics use in similarly aged women? We can also consider the effects observer age has on cosmetics. Older men prefer to mate with younger women because of their fertility (Buss & Schmitt, 1993). How do older men respond to the effects of cosmetics? Are they affected in the same way as a younger sample of men? Finally, we can also ask how younger men and women respond to cosmetics use in older women. Older women do not pose as much of a threat to younger women in terms of fertility and attractiveness, nor are they are as desired by men (Mathes, Brennan, Haugen, & Rice, 1985). We explore the attractiveness perceptions of younger and older adults have of faces that are both younger and older, and are also with and without cosmetics, in the following experiment.

4.8 Methods

4.8.1 Models

For this study, we used the same 44 models from the Experiment 1, which we class here as our younger models. An additional 44 women were recruited as older models (age *M* = 45.75, *SD* = 4.54) from a participant panel at a major cosmetics company. All reported their ethnicity as White, and gave full consent for their photographs to be used, and were given a gift voucher for their participation.

Stimuli. The stimuli for the younger models was the same as in Experiment 1. The stimuli for the older models was produced in a very similar manner to the younger adults. Photographs were captured using a Nikon D1-X digital camera, with two diffuse Espirit 500 lights. Models were provided with an identical range of cosmetics, and were rotated and cropped in the same manner as the younger model group. An example of an older model with and without cosmetics is illustrated in Figure 5.

Figure 5. An example image of an older model without (left) and with (right) cosmetics. Models followed a typical cosmetics application, similarly to the younger models.

4.8.2 Observers

Several experiments were carried out in order to collect ratings of faces with and without cosmetics across both observer age groups and model age groups. We discuss the various procedures below.

Experiment 3.1. Fifty three observers (age *M* = 20.88, *SD* = 3.59, 25 males) from Bangor University participated for course credit. The procedure was similar to that of Experiment 1, in that participants rated either the young models None (*n* = 27, age *M* = 21.00, *SD* = 3.35, 13 males) or Night Out (*n* = 26, age *M* = 20.77, *SD* = 3.89, 12 males) cosmetic looks. Participants were asked “How attractive is this person?” and rated on a scale of one to seven, as before.

Experiment 3.2. Forty six observers (age *M* = 20.78, *SD* = 5.82, 15 males) from Bangor University participated for course credit. The procedure was the same as Experiment 1, only this time participants rated either the older models None (*n* = 22, age *M* = 22.18, *SD* = 8.16, 6 males) or Night Out (*n* = 24, age *M* = 19.50, *SD* = 1.35, 9 males) cosmetic looks. Participants were asked the same question as above and rated on the same scale.

Experiment 3.3. Seventy one older adult observers (age *M* = 42.55, *SD* = 5.16, 35 males) were recruited from a panel of volunteers at a major cosmetics company. Participants completed an online experiment in which they rated faces of both younger and older models in a random order, for either the None (*n* = 35, age *M* = 42.03, *SD* = 5.04, 12 males) or Night Out (*n* = 36, age *M* = 43.05, *SD* = 5.29, 23 males), totalling 88 trials. As before, participants were asked “How attractive is this person?” and indicated their response via a mouse click on a scale of one to seven.

4.8.3 Results

For each models cosmetic look, we averaged the ratings given for both older and younger men and women, so that each model had eight scores. We examined differences using a 2 (Observer Sex: Female, Male) x 2 (Observer Age: Younger, Older) x 2 (Model Group: Young, Old) x 2 (Cosmetics: None, Night Out) ANOVA.

We found a high order interaction across all variables, $F(1, 86) = 14.10$, $p < .001$, $\eta^2_p = .14$, and significance for all three way interactions (all *F'*s > 25.66, all *p*s < .001). Furthermore, five two way interactions were significant (all *F'*s > 6.86, all *p*s < .01). Given the complexity of interpreting such findings, we break down our analysis into two separate three way ANOVA's of Observer Age x Cosmetics x Observer Sex, for both the Young and Old model groups. This allows us to examine the differences between younger and older observers across our core variables of interest: Sex and Cosmetics. The key interactions are illustrated in Figure 5.

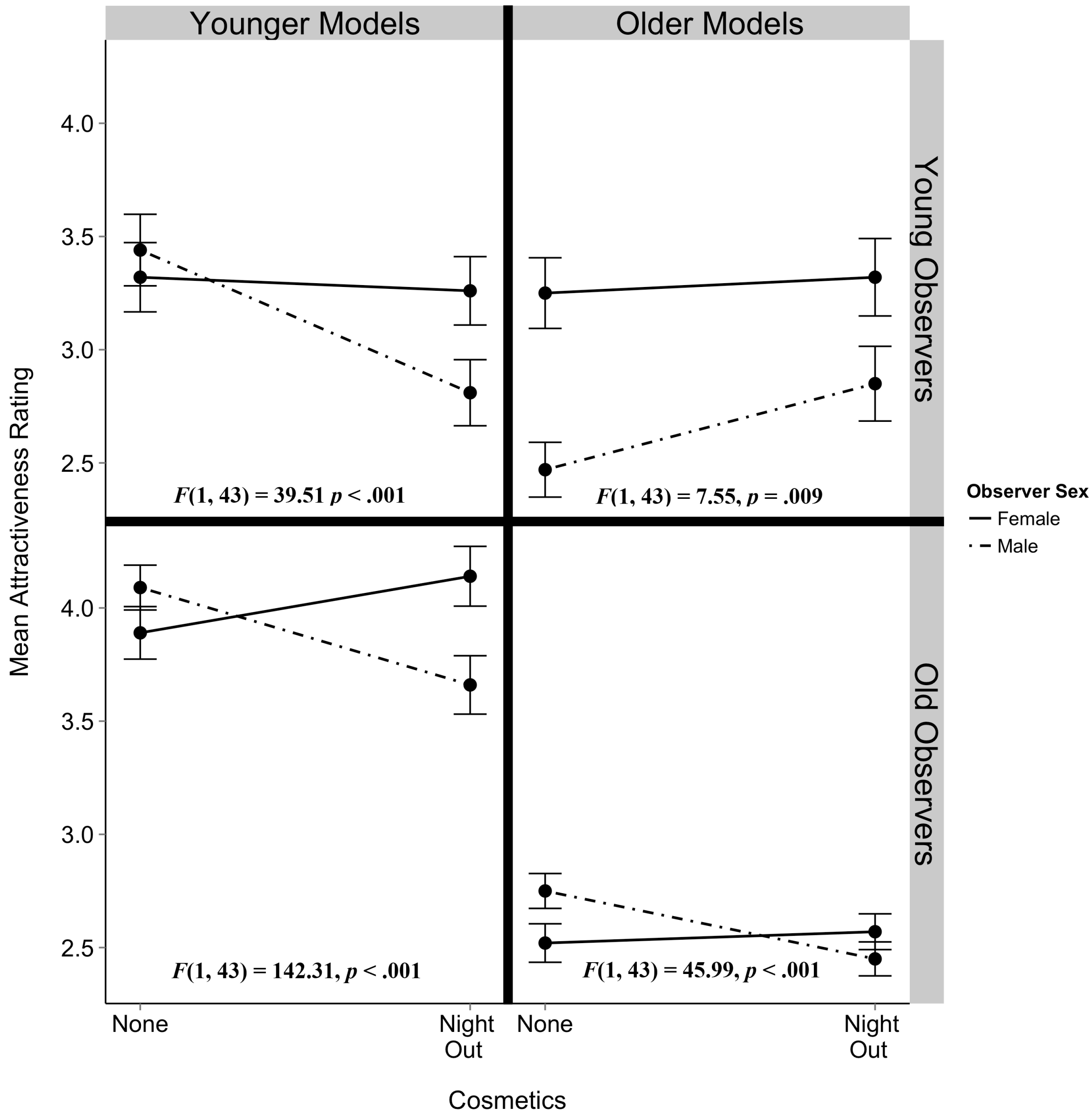

Figure 6. Interactions between Cosmetics and Observer Sex at each level of Model Group and Observer Age. Generally, males rated lower than females when cosmetics were applied, except for younger males when judging older models. Only older females rated higher when cosmetics were applied to younger models.

Younger Model Group. A 2 x 2 x 2 ANOVA revealed a significant main effect of Observer Age, $F(1, 43) = 138.74$, $p < .001$, $\eta^2_p = .76$. Older adults generally rated higher ($M = 3.95$) than younger adults ($M = 3.21$). There was also a significant main effect of Cosmetics

F(1 ,43) = 10.16, p = .003, η^2_p = .19, with Night Out cosmetics looks having lower ratings (M = 3.46) than None (M = 3.21). Additionally, there was a significant main effect of Observer Sex, F(1, 43) = 15.94, p < .001, η^2_p = .27. Consistent with our previous findings, males rated lower (M = 3.50) than females (M = 3.65). We also found a significant interaction of Observer Age and Cosmetics, F(1, 43) = 19.94, p < .001, η^2_p = .32, which we do not follow up here. There was no Observer Age by Observer Sex interaction, F(1, 43) = .12, p = .75. Of more interest is a significant interaction between Cosmetics and Observer Sex, F(1 ,43) = 122.81, p < .001, η^2_p = .74, and the lack of a three way interaction, F(1, 43) = 0.94, p = .33, indicating the Cosmetics by Observer Sex interaction is equivalent across both observer age groups. Upon examining this further, we find that younger males rated significantly lower for faces in the Night Out condition, t(43) = 6.97, p < .001, r^2 = .53, while younger females did not differ, t(43) = .73, p = .47. Older males, similarly, rated lower when models wore cosmetics, t(43) = 5.35, p < .001, r^2 = .40. Older females ratings increased with cosmetics, t (43) = 3.18, p = .003, r^2 = .19. We present the Cosmetics by Sex interaction at both levels of Observer Age in Figure 5.

Older Model Group. Another 2 x 2 x 2 ANOVA revealed another main effect of Observer Age, F(1, 43) = 5.71, p = .02, η^2_p = .12. Younger observers rated slightly higher (M = 2.97) than older observers (M = 2.57) when rating older models. There was no main effect of Cosmetics, F(1, 43) = 1.32, p = .26, but a similar main effect of Observer Sex, F(1, 43) = 72.05, p < .001, η^2_p = .63, in that males again rated lower (M = 2.63) than females (M = 2.92). We found no significant interaction between Cosmetics and Observer Sex, F(1, 43) = 0.09, p = .76, though there were significant interactions between Observer Age and Observer Sex, F (1, 43) = 113.85, p < .001, η^2_p = .73, as well as Observer Age and Cosmetics, F(1, 43) =

17.66, $p < .001$, $\eta^2_p = .29$. We do not explore these further in light of the significant three way interaction between Observer Age, Cosmetics, and Observer Sex, $F(1, 43) = 35.91$, $p < .001$, $\eta^2_p = .46$. We examined the interaction between Observer Sex and Cosmetics for both younger, $F(1, 43) = 7.55$, $p = .009$, $\eta^2_p = .15$, and older observers, $F(1, 43) = 45.99$, $p < .001$, $\eta^2_p = .52$, and observed two distinct patterns. For younger males, rating older models with cosmetics led to an increase in attractiveness ratings, $t(43) = 3.73$, $p = .001$, $r^2 = .24$. Younger females were unaffected by cosmetics, $t(43) = 0.89$, $p = .38$. Older males showed a similar pattern to previous findings, in that they rated older models as less attractive with cosmetics, $t(43) = 7.56$, $p < .001$, $r^2 = .57$. Older females ratings were unaffected by the cosmetics use of similarly aged women, $t(43) = 0.82$, $p = .42$. These interactions are summarised in Figure 5.

4.9 Discussion

We further investigated the effect of cosmetics on social perceptions, this time extending the analyses across both the age of the observer and the age of the model. We aimed here to address the issue of whether females use cosmetics to attract a mate, or to impress upon other females. Except for younger males rating more favourably for older models, male observers rated lower for attractiveness when cosmetics were applied, regardless of their age, or of the age of the model. We also found, surprisingly, that younger female observers were unaffected by cosmetics use. However, older female observers rated younger models with cosmetics as significantly more attractive with cosmetics than without.

These findings suggest that younger females are not influenced by cosmetics when it comes to ratings of attractiveness, regardless of the age of the model. Contrary to our previous findings, in which younger female observers rated more favourably for social traits, the younger female observers here show no differences between cosmetics conditions, suggesting that cosmetics may not be used for competition. However, older female observers rated younger, but not older, models with cosmetics as more attractive. This might suggest that older females are more impressed by the beautifying effects of faces than younger females. Younger faces have greater contrast than older faces (Porcheron et al., 2013), and a youthful face is a critical predictor of attractiveness whatever the individuals age (Furnham, Mistry, & McClelland, 2003). It could be that older females who do not possess such attributes are more impressed with the cosmetics use of younger rivals, but the lack of difference in younger females suggests cosmetics may not be strictly for competition, if at all. However, this findings may reflect general perceptions toward female attractiveness, whereby younger females are generally more attractive, regardless of cosmetics (Cunningham, 1986).

However, one of the most consistent findings across observer ages and model groups was that males rated lower when cosmetics were applied. This is in line with our earlier findings in Experiment 1, in that males rated higher for faces without cosmetics for many social traits. Here we find that younger male observers, when considering the attractiveness of similarly aged females, judge them to be on average more attractive without cosmetics. Older male observers demonstrated the same pattern as younger males, rating faces without cosmetics as more attractive, no matter the age of the model. Furthermore, older males showed a similar pattern when judging older females. Given a sample of models of a similar age group, males still rated higher for attractiveness when no cosmetics were applied. An exception to this general finding was that when younger male observers rated older models, ratings of attractiveness increased with cosmetics. Though younger males show a preference for older women in line with evolutionary life history models, the optimal age for female attractiveness seems to fall around 25 (Kenrick, Keefe, Gabrielidis, & Cornelius, 1996). It is unlikely that cosmetics would make older models appear sufficiently youthful to be attractive to younger males in this sense. However, given that males are sensitive to facial cues that signal attractiveness (Jones, 1995), it may be that cosmetics application improves age related declines in skin texture (Fink et al., 2006; Porcheron et al., 2013) leading to an increase in attractiveness. As expected, however, the ratings of older adults were significantly lower across levels of cosmetics and observer sex, indicating the ratings are valid.

The present study has several methodological issues. First, the separate samples that constitute raters completed the experiments in different ways. The younger samples completed the experiment under laboratory conditions, whereas the older sample completed ratings online at their leisure. Due to logistic constraints, the older sample of raters saw both younger and older faces in either of the cosmetics condition. This may have exaggerated the differences between older and younger models - older models may have been rated less favourably with a comparison to a younger model. The unusual result we obtained from younger males rating older models may have been due to a small sample size. In that group, there were far fewer males than in the other conditions, so the results must be interpreted with caution, especially so given the unusual nature of the finding. However, in spite of this, we demonstrate consistent findings of female observers being relatively unaffected by cosmetics, and male observers generally rating cosmetics as less attractive.

Using a largely representative sample of both cosmetics users and a wide range of observers, we demonstrate that for perceptions of attractiveness, females are generally unaffected by an application of cosmetics. However, we find generally that males of all ages find faces with cosmetics to be less attractive than faces with cosmetics, regardless of the age of the model. Given these results, it seems unlikely that cosmetics are used directly for competition. However, cosmetics are certainly not attracting males - ratings of both social traits and attractiveness are significantly lower with cosmetics. Assuming the conventional account (Buss, 1988) is correct, and women do use cosmetics to attract men, our findings point to a social account in which the use of cosmetics is miscalibrated to the preferences of males. We demonstrate some evidence of this from Experiment 2, in which an excessive amount of cosmetics were worn for the optimisation of social traits.

The findings in this chapter are of direct interest to cosmetics manufacturers. Using a representative sample of cosmetics consumers and observers, we demonstrate here that a common application, in general, is not attractive to males, and results in more negative perceptions of social traits. The use of cosmetics is an extremely widespread behaviour, and is tied to self consciousness, image and confidence, with some females believing more cosmetics boosts positive social interactions (Miller & Cox, 1982). This mistaken belief, that using cosmetics enhances appearance and therefore social interactions, may be propagated through media and cultural factors like other body image stereotypes (Clay, Vignoles, & Dittmar, 2005). Certainly cosmetics manufacturers are in a position of power to correct these mistaken beliefs.

The next step

The evidence in this chapter indicates that an application of cosmetics, in general, is not attractive to male observers, in spite of boosting perceptions of social traits for female observers. In the next chapter, I investigate the preferences male and female observers have for amounts of cosmetics. Further to this, I also attempt to to contextualise the attractiveness judgements to unearth the ideas individuals hold about the preferences of others. In doing so, I aim to further elaborate on why male ratings are consistently lower with cosmetics, and to further explore the nature of the discrepancy between cosmetics and attractiveness.

CHAPTER 5: Miscalibrations in attractiveness judgements with cosmetics[2]

Abstract

Women use cosmetics to enhance their attractiveness. How successful they are in doing so remains unknown - how do men and women respond to cosmetics use in terms of attractiveness? There are a variety of miscalibrations where attractiveness is concerned - often, what one sex thinks the opposite sex finds attractive is incorrect. Here, we investigated observer perceptions about attractiveness and cosmetics, as well as their understanding of what others would find attractive. We used computer graphic techniques to allow observers to vary the amount of cosmetics applied to a series of female faces. We asked observers to optimise attractiveness for themselves, for what they thought women in general would prefer, and what they thought men in general would prefer. We found that men and women agree on the amount of cosmetics they find attractive, but overestimate the preferences of women, and when considering the preferences of men, overestimated even more. We also find that models self-applied cosmetics is far in excess of individual preferences. These findings suggest attractiveness with cosmetics is a form of pluralistic ignorance, whereby women tailor their cosmetics use to an inaccurate perception of others' preferences. These findings also highlight further miscalibrations of attractiveness ideals.

5.1 Introduction

Self adornment is an important social behaviour by any standard. Throughout the animal world, the more ornamented sex is typically the one investing less in offspring

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[2] This chapter is has been accepted for publication at the time of binding:
Jones, A. L., Kramer, R. S. S., & Ward, R. (under review). Miscalibrations in judgements of attractiveness with cosmetics. *Quarterly Journal of Experimental Psychology.*

(Trivers, 1972). Though ornamentation is more balanced in humans, given the more equal amounts of parental investment, in modern society self adornment is more prevalent in women. Perhaps the best example of this is the use of facial cosmetics. By some estimates, the value of the global broad cosmetics industry was around €136 billion in 2006 (Rossi, Prlic, & Hoffman, 2007). Here we examine a basic question relating to the use of cosmetics and attractiveness. How do cosmetics affect men's and women's perceptions of attractiveness? Research has identified several important and consistent predictors of attractiveness. For example, facial symmetry (Grammer & Thornhill, 1994), averageness (Alley & Cunningham, 1991) and sexual dimorphism (Johnston & Franklin, 1993) greatly influence perceived attractiveness. Skin condition is also important - homogeneously textured skin is a strong signal of health (Samson, Fink & Matts, 2010), while reddened lips may be a cue to healthy circulation (Stephen & McKeegan, 2010). Females also have lighter skin than males (Jablonski & Chaplin, 2000) and this difference is consistent across ethnicities (Russell, 2009). The contrast between skin and facial features (e.g. eyes and mouth) is greater in female faces, and influences perceptions of femininity (Russell, 2009). Additionally, men find women with higher skin luminance more attractive (Russell, 2003).

It is no surprise that cosmetics act on these properties. Cosmetics increase facial contrast (Russell, 2009), exaggerating sex typical differences in faces. Cosmetics also homogenise skin texture (Samson et al., 2010), and may alter colour properties linked to healthy skin (Stephen, Coetzee, & Perrett, 2011) such as yellowness and lightness (Stephen, Law-Smith, Stirratt, & Perrett, 2009). Some cosmetic products seem specifically tailored to modifying these perceptions. For example, blushers typically add redness to the face, which is tied to circulatory health and a healthy appearance (Stephen, Coetzee, Law-Smith, &

Perrett, 2009). Cosmetics can also increase perceptions of health (Mulhern et al., 2003), and also increased skin lightness (Russell, 2009). Moreover, women with greater asymmetries around the mouth spend more time applying cosmetics in this area (Korichi, Pell de Queral, & Gazano, 2011), supporting the role of the lips in signalling health (Stephen & McKeegan, 2010). Most importantly, these cosmetics practices have been shown to consistently increase attractiveness (Etcoff et al, 2011; Mulhern et al., 2003). Cosmetics, then, allow women to increase their facial attractiveness by modifying attributes that influence attractiveness in unadorned faces.

Both popular media and scholarly sources (Buss, 1988; Singh, 2004) suggest that women use cosmetics as a mate attraction tactic, in a similar way as clothing (Durante, Li, & Haselton, 2008). One possibility therefore is that women apply cosmetics specifically to appeal to men. If so, then we might expect women to apply cosmetics so as to be maximally attractive to men, and for men to respond more favourably than women to cosmetics use. An alternative is that women use cosmetics not to attract men, but to compete with women. For example, women are more sensitive to the opinion of other women than of men when it comes to their own attractiveness (Graziano et al., 1993), and the primary avenue of competition between women is appearance (Campbell, 2004). Women perceive attractive other women as socially dominant (Dijkstra & Buunk, 2001), and are jealous when other women surpass them in attractiveness (Buss et al., 2000). It is therefore plausible that women are motivated to appear attractive to both men and women, and use cosmetics to achieve this goal.

However, there are a number of perceptions individuals hold about the beliefs, attitudes and preferences of the opposite sex that are highly inaccurate. A specific example relates to attractive body shapes. Women believe men prefer much thinner body shapes than men actually do (Fallon & Rozin, 1985), while men believe women have a preference for much more muscular body shapes than women do (Pope et al., 2000). These attractiveness miscalibrations seem to be a form of pluralistic ignorance. The ideals of attractiveness held by one sex are very different from the personal preferences of the other sex, which are surely the preferences that should be appealed to. These false perceptions are upheld through the assumption that the opposite sex really do prefer the assumed trait (Prentice & Miller, 1993), assumptions that may also be fuelled by media sources (Clay, Vignoles, & Dittmar, 2005). Cosmetics are an easy way of modifying appearance compared to diets and exercise, and act upon the most salient signal of our attractiveness - the face (Currie & Little, 2009). Are there similar miscalibrations of attractiveness with cosmetics?

We seek to address two issues relating to cosmetics use and attractiveness. We first examine how men and women respond to cosmetics, and in doing so, attempt to uncover who, if anyone, women are tailoring their cosmetics to. Secondly, we examine whether there are errors and miscalibrations in this tailoring. To address these issues, we photographed a sample of young women before and after they applied facial cosmetics for “a night out”. By generating a smooth sequence of images between these photographs we allowed participants to select the level of cosmetics they found maximally attractive for each face. We asked participants to judge not only their personal preferences of attractiveness, but also what they thought others might prefer. Though there are several factors influencing attractiveness, there is still considerable inter-individual variance in attractiveness judgements (Kościński, 2008). This may be compounded by cosmetics use, which shows a great deal of cultural variation (Russell, 2010). We therefore wanted to contexualise the question by asking observers to assess attractiveness from different perspectives: what they personally preferred, and what they thought men in general and women in general preferred. By providing a perspective for the attractiveness judgement, we first intended to reduce the variance of responses that might arise if people answered the question according to different criteria. Most importantly, we can also examine differences between individual preferences of attractiveness and cosmetics, and what they believe others prefer - does cosmetics use show pluralistic ignorance?

5.2 Method

5.2.1 Models and stimulus generation

Forty-four women (age in years, $M = 21.18$, $SD = 1.94$) participated as models. All self reported as White ethnicity, and gave full consent for their photographs to be used. All were paid £6 for their participation.

Stimulus sequence generation. We asked models to remove all traces of facial jewellery as well as thoroughly clean their face of all cosmetic products. Models also tied their hair back from their face. We photographed models using a Nikon D3000 SLR camera mounted on a tripod, at a distance of approximately one metre, in a room with no other sources of lighting. Models were photographed against a white background, with a Nikon SS-400 flash angled 45º towards the ceiling. We photographed each model three times, and used the clearest exposure as our final stimuli. After the initial photograph, models were provided with a range of best-selling foundation, lipstick, mascara and blushers, and were instructed to apply their cosmetics as though they were going on a “night out”. They were then photographed again to capture their appearance with cosmetics. Between shots, camera settings were kept constant, including lens aperture (F5.3), exposure time (1/60 seconds) and

ISO speed rating (200). All photographs were subsequently rotated so the pupils lay along the same transverse plane, and were cropped to just above the hairline, to below the chin, and to just outside the widest point of the face.

A series of 160 landmarks were added to each model using JPsychomorph (Tiddeman, Burt, & Perrett, 2001). For each model, we generated a sequence of images which moved from their natural appearance (defined as zero percent) to their night out look with cosmetics (defined as 100%). To avoid any floor or ceiling effects, sequences started at -50%, which exaggerated their appearance without cosmetics, and to 150%, which exaggerated their appearance with cosmetics. The transform sequence can be simply thought of as taking the difference between the 100% image and the zero percent image, and multiplying this difference by the desired transform level (e.g., 50%). Finally, these values are added to the original image to complete the transform

JPsychomorph uses a wavelet Markov Random Field (MRF) method for interpolating realistic, fine grain textures (Tiddeman, Stirratt, & Perrett, 2005). Using this method, high resolution information such as colour and texture in a transformed image is calculated by assuming the new pixel distribution is dependent on the values in the local neighbourhood of landmark points. With this method, variations in intensity change linearly across any given sequence, with the result being blurring at intermediate steps is removed or greatly reduced. This ensures highly realistic images within the sequences for each model. Additionally, a Procrustes fit is performed before sequence generation, which aligns the images as precisely as possible, resulting in a cleaner transform and further reducing transformation artefacts.

For each model, the final sequence contained 21 images, ranging from -50% to 150% in increments of 10%. Models appeared to increase the amount of cosmetics worn as participants moved through the sequence. An example of the difference between the two cosmetics conditions are demonstrated with average faces in Figure 1, and an example set of photographs in Figure 2 demonstrate a 50% shifted image and the two anchor points, demonstrating the realism of the sequences.

Figure 1. The average faces of all 44 models in both cosmetics conditions, None (left) and Night (right). This figure illustrates the typical use of cosmetics in the study. The left image represents the average face without 0% cosmetics, while the right represents the average face with 100% cosmetics. Participants selected from a range of -50% to 150% cosmetics.

Figure 2. An example set of faces from one models' sequence. The image on the left represents the original, no cosmetics photograph, and the image on the right is the original cosmetics photograph. The image in the middle represents the model interpolated half way through the sequence, at 50% cosmetics.

5.2.2 Participants

Forty-four observers (age $M = 20.06$, $SD = 1.97$, 22 males) from Bangor University participated for course credit.

5.2.3 Procedure

The presentation order of models was randomised, and each trial began with a random image from their sequence. Underneath the face was a white circle, with a red bar over a random point of the circumference. The bar could be moved around the circle using left and right arrow keys. Each position of the bar corresponded to an image in the model's image sequence, and movement of the bar altered the image. One full cycle caused the image to move smoothly through the sequence completely and back again. For each trial, the starting position of the bar and the image corresponding to its position were randomised.

Participants assessed all the models in three separate blocks, adopting a different perspective in each block: Participants were asked to optimise the attractiveness of the faces for themselves (Self Perspective); for what they thought women in general would prefer (To Women Perspective); and for what they thought men in general would prefer (To Men Perspective). These definitions were placed at the top of the screen throughout the respective blocks. On each trial, participants moved through the sequences of each model with the arrow keys, and pressed the spacebar once they felt they had reached optimal attractiveness for the current perspective. Responses were untimed and unspeeded. The percentage of cosmetics use corresponding to the selected image was then recorded as the participant's response, although this value was not seen by participants. The block order was counterbalanced across participants.

5.3 Results

For each model, we calculated the average selection for optimal attractiveness for all three perspectives, for both male and female observers. These results are shown in Figure 3. A 2 (Observer Sex: Female, Male) x 3 (Perspective: Self, To Women, To Men) ANOVA revealed a significant main effect of Observer Sex, $F(1, 43) = 7.54$, $p = .009$, $\eta^2_p = .15$, such that women selected slightly higher amounts of cosmetics than did men. While significant, this difference of approximately 3% was small compared to the significant main effect of Perspective, $F(2, 86) = 149.41$, $p < .0001$, $\eta^2_p = .77$. Post-hoc comparisons between perspectives highlight ways in which observers of both sexes reported inaccurate views about how others respond to cosmetics. As shown by the comparison of the 'To Men' and 'To Women' perspective in Figure 3, observers judged that men would prefer significantly more cosmetics than would women, $t(43) = 8.55$, $p < .0001$, $r^2 = .63$. However, this judgement was incorrect. Looking at the results for the 'Self' perspective in Figure 3, we find that if anything, women trended towards preferring slightly more cosmetics than men did, $t(43) = 1.89$, $p = .06$, $r^2 = .07$.

The large gap between the 'Self' and other perspective highlights a second, related error of judgement. Observers of both sex judged that other people would prefer higher levels of cosmetics use than they themselves did, reflected by the difference between the 'Self' and 'To Women' perspectives, $t(43) = 10.33$, $p < .0001$, $r^2 = .71$, and the 'Self' and 'To Men' perspectives, $t(43) = 15.22$, $p < .0001$, $r^2 = .84$.

Finally, we see a third intriguing error of judgement, this time by the models rather than the observers. Models used more makeup than observers found attractive, evident from the fact that the personal preferences of observers (Self Perspective) was significantly different from 100% (i.e. how much the models actually applied) for both sexes, ts > 445.49, ps < .0001.

We checked whether model attractiveness and the application of cosmetics might have been entangled in some way. For example, observers might have preferred the way in which more attractive models used cosmetics, or perhaps more attractive models benefit differently from using cosmetics than less attractive ones. To this end, we repeated our main analysis as a 2 (Sex) x 3 (Perspective) ANCOVA, with attractiveness of the models without cosmetics, rated by 27 participants (age $M = 21$, $SD = 3.35$, 14 females) on a seven point scale, as a covariate. The pattern of results was unaffected, although effect sizes were smaller, with significant main effects of Sex, $F(1, 42) = 5.73$, $p = .02$, $\eta^2_p = .12$; Perspective, $F(2, 86) = 4.42$, $p = .01$, $\eta^2_p = .09$; and no interaction, $F(1, 43) = 0.23$, $p = .79$, $\eta^2_p = .00$.We also checked whether there were any correlations between rated attractiveness and the amount of cosmetics applied in the different blocks, all *r*s between -.14 and .17, all *p*s > .27.

We considered whether the consistent preference for faces wearing less than 100% cosmetics was due to artefacts from the sequence generation process. Our intermediate faces reflect an average of of two faces (e.g., the 50% image is a composite of the 0% image and the 100% image). With traditional averaging methods, composites from multiple faces produce smoother skin texture and a more attractive appearance (Little & Hancock, 2002). Although the use of wavelet MRF texture transform is intended to reduce or remove this possibility (Tiddeman, Stirratt, & Perrett, 2005), we examined the issue empirically. We cropped a 114 x 114 patch of skin from the right cheek of each model in her 0% no cosmetics image, her 50% sequence image, and her self-applied 100% cosmetics image. Each of these sets were rated for attractiveness (on a scale of 1-7) by a different set of 12 participants. If the preference for intermediate faces was due simply to more attractive skin textures due to averaging, then we would expect the skin of the 50% transform to be more attractive than both the 0% and 100% natural images. However, although both the 0% and 50% patches were rated as more attractive than the 100% patch (M = 3.51, SE = .12), the 50% patch was actually non-significantly less attractive (M = 3.89, SE = .12) than the 0% patch (M = 4.06, SE = .11), p = .09. It therefore seems unlikely that the consistent preference for intermediate composites reflects a skin-smoothing artefact of the averaging process.

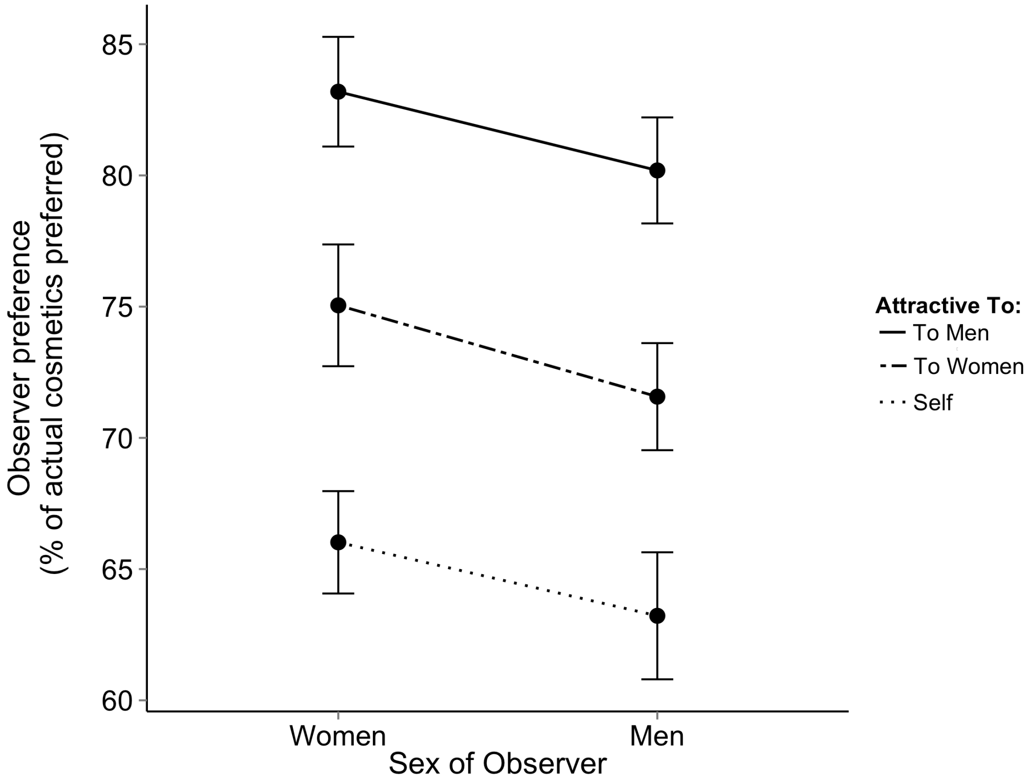

Figure 3. The average amount of cosmetics preferred by women and men. Error bars represent one standard error. Note how even the highest estimates do not approximate the actual amount of cosmetics worn by models at 100%.

5.4 Discussion

We found a variety of miscalibrations and errors in people's judgements about cosmetics use. Observers of both sexes judged, incorrectly, that men would prefer significantly more cosmetics than would women. Instead we found that men and women had similar preferences for cosmetics use. Observers of both sexes also significantly overestimated how much cosmetics other people would prefer. These misjudgements of other people's reactions and preferences to cosmetics also seem to have been carried by the models themselves: The amount of cosmetics the models actually wore was significantly higher than observer's personal preferences, and even higher than observers' overinflated estimates of what others would prefer. Taken together, these results suggest that women are likely wearing cosmetics to appeal to the mistaken preferences of others. These mistaken preferences seem more tied to the perceived expectancies of men, and, to a lesser degree, of women.

Although we saw little difference in personal preferences, our observers reported that men would prefer relatively higher levels of cosmetics than would women. This is consistent with the belief that men prefer an exaggerated sex typical appearance - in this case, a 'supernormal' face. In animal studies, supernormal attributes such as experimentally lengthened tails can increase mating success (Winquist & Lemon, 1994). Cosmetics likely function in humans in a similar fashion (Etcoff et al., 2011), and this may explain the discrepancy between men's actual preferences and their estimated preferences. Non-human animals have been shown to exaggerate colour cues or other visual features to increase their mating success, though these behaviours cause the opposite sex to decipher what is a real or deceptive signal of mate value (Trivers, 1985). While the general consensus is that more cosmetics are more attractive, at the individual level men may realise these alterations are essentially deceptive, since they modify and mask important cues to mate value (Samson et al., 2010; Stephen & McKeegan, 2010).

Our sample of models self applied their cosmetics, resulting in an ecologically valid use. A surprising proportion of studies looking at cosmetics employ the use of a professional makeup artist to apply cosmetics (Etcoff et al., 2011). In reality, the application of cosmetics in these studies reflect the preferences and ideals of one individual and tell us little about how individuals alter their own appearance. Our participants were instructed to apply cosmetics for a "night out", and so may have been applied with ideas of low lighting, a particular dress style, etc. However, as demonstrated in Figure 1, there was nothing especially unusual in the way the sample of models applied cosmetics. The style appears to conform closely to what Russell (2010) calls the 'received style', with cosmetics being applied to exaggerate areas of contrast around the eyes and mouth. Additionally, though there is the potential for the over-application of cosmetics to alter with another style, it does not explain the results where observers over-estimate what others want, nor that observers believe that men prefer more cosmetics than women. However, it is possible that an application of cosmetics made models feel more confident, which could have led to minute but perceptible changes in expression or posture. Other studies have demonstrated that individuals appear more confident after an application of cosmetics (Mulhern et al., 2003), and that individuals report greater satisfaction with social interactions whilst wearing makeup (Miller & Cox, 1982).

A possible limitation concerns the fact that the images in our sequences are derived from a pair of images for each model, and as such, are not exactly like a real face. Were this the case, we could not be sure the actual amount of cosmetics worn by the models is beyond optimal levels, but is instead due to preferences for an 'averaged' skin texture which may be present throughout the sequence. A simple comparison of faces in the sequence and natural images would be confounded by the presence of cosmetics. However, examination of the attractiveness of skin patches from a face in the sequence and the two natural photographs demonstrated the 100% cosmetics skin was less attractive than both the 50% transform and the natural appearance. These results indicate that the amount of cosmetics worn by models is indeed beyond optimal levels of attractiveness, and is particularly valid as small skin samples are predictive of overall face attractiveness (Jones, Little, Burt, & Perrett, 2004).

It seems that the models in our sample were using cosmetics to appeal to mistaken beliefs about what men, and to a lesser degree other women, would prefer. Such mistaken beliefs are also common when women consider what body shape men find attractive (Bergstrom, Neighbors & Lewis, 2004). Media portrayals of idealised, attractive women tend to possess supernormal properties (Barrett, 2010) such as flawless skin, low waist to hip ratios (Singh, 2004) and youthful features. Many of these portrayals cause great dissatisfaction in women regarding their own levels of facial and bodily attractiveness (Li et al., 2010), and starts at an early age (Hargreaves & Tiggermann, 2004). Further associations between beauty and positive life outcomes are propagated by media aimed at adolescent (Clay et al., 2005), and older individuals (Becker et al., 2005). These errors can be viewed under the broad umbrella of pluralistic ignorance, of which our results are another example. Our observers believed others, especially men, preferred higher amounts of cosmetics than the observers personally did. Additionally, our models seemed to be perpetuating the mistaken belief that more cosmetics is more attractive, by wearing excessive amounts. Our female observers indicated the amount of cosmetics for optimal attractiveness was lower than the amount worn by the models, who were a sample of similarly aged peers. This suggests that while there is a sense of what is optimally attractive, it may be overlooked in order to conform to stereotyped ideals, and mistaken notions of what others will find attractive.

The next step

In the final experimental chapter, I attempt to understand why cosmetics alter perceptions. Facial contrast has been shown to change with cosmetics use, and is related to aspects of age and sex typicality (Russell, 2009). The luminance changes with cosmetics have been established, and reflect sexual dimorphism. However, it is unknown whether cosmetics reflect further dimorphisms in other colour channels, or whether other facial features previously unconsidered are also different. These are investigated in the following chapter.

CHAPTER 6: Sex differences in feature contrasts and the effects of cosmetics

Abstract

A typical application of cosmetics alters the luminance contrast across different facial features, enhancing natural sex differences in skin luminance. This serves to increase perceptions of femininity and attractiveness, but cosmetics also affect a range of other social judgements, including health. Perceptions of health from the face are strongly influenced by various patterns of CIELab colouration. We present two studies in which we establish sex differences in feature contrasts across colour channels and race, and then determine the contrast and colour changes from a typical application of cosmetics. We find that females and males differ most strongly in terms of luminance contrasts around the brows and eyes, which is consistent across race. We also find that cosmetics application enhances such sex differences in luminance contrast around the eyes and brows, but enhances contrasts in other colour channels that are associated with both health and youthfulness. We also highlight discrepancies in previous literature concerning mouth contrast. Together our studies demonstrate the action of cosmetics on the exaggeration of sexually dimorphic contrasts, as well as the enhancement of other colour contrasts which have links with health and youthfulness.

6.1 Introduction

When investigating facial attractiveness, a prevailing approach has been to identify the morphological characteristics that are perceived as attractive. Faces that are symmetrical (Grammer & Thornhill, 1994), possess average proportions (Alley & Cunningham, 1991), and are more typical of the sex they belong to- that is, they are sexually dimorphic (Johnston & Franklin, 1993), are seen as more attractive. More recently, research has identified that attractiveness may indeed be skin deep, with visible skin condition and colouration being particularly important cues to attractiveness, especially in women (Samson, Fink, & Matts, 2010).

Attractive skin is healthy skin. Desirable skin has properties that fall into two related domains; texture, and colour. Homogenous, even textured skin is an important cue for both health and attractiveness, signalling that the individual is free from pathogens or infection (Fink, Grammer, & Thornhill, 2001). Smooth skin texture is indicative of high levels of oestrogen and low levels of androgens (Lucky, 1995; Fink & Neave, 2005). Additionally, when separating the contributions of skin texture and shape to accurate identification of health, skin texture contribute significantly more to accurate judgements of health than did facial shape (Jones, Kramer, & Ward, 2012).

More subtle facial cues to health and attractiveness come in the form of colour. A growing body of work has shown that certain colour properties are perceived as healthy. Stephen, Coetzee, Law-Smith and Perrett (2009) demonstrated that people prefer faces to have higher levels of oxygenated blood, compared to deoxygenated blood, as it signals a healthy circulatory system. Other studies have utilised the CIELab colour space to examine colour properties in faces. The model is based on the way the human visual system perceives colour, and therefore yields information about skin colour in meaningful terms (Weatherall & Coombs, 1992). It consists of three channels, dark to light (L^*), green to red (a^*), and blue to yellow (b^*). When considering health, individuals increase redness, or a^* colouration, in faces that are low on these properties (Stephen, Law-Smith, Stirratt, & Perrett, 2009). The same study also found that when optimising health, people also prefer higher levels of luminance and yellow colouration in faces, though favour more luminance properties in females. Interestingly, b^* colour properties are linked with carotenoids - organic pigments found in fruit and vegetables (Rao & Rao, 2007). In non human animals, carotenoid induced yellowness signals health (Lozano, 1994). Similarly, in human faces, higher levels of skin yellowness are judged as more healthy, and, after individuals consume a diet rich in carotenoids, their skin increases in the amount of yellow colouration (Stephen, Coetzee, & Perrett, 2011).

A small number of colour differences between males and females have been observed, suggesting a sexual dimorphism in colour. Males tend to have redder faces than females, possibly due to a higher peak blood flow (Stephen et al., 2009). Females tend to have lighter skin (Jablonksi & Chaplin, 2000), a trait considered attractive by males (Van den Berghe & Frost, 1986, but see Fink, Grammer, & Thornhill, 2001). Indeed, if face images are passed through a filter, leaving only low level information, they are rated as more attractive if the remaining blurred properties are brighter (Sadr, Fatke, Massay, & Sinha, 2002), suggesting low level colour properties are strong influences on attractiveness. Further to this, Russell (2003) observed that it is actually the difference in luminance between the eyes and mouth and the rest of the face that contributes to attractiveness. When this difference is increased, female faces become more attractive, while the reverse is true for male faces. Later, Russell

(2009) demonstrated a sex difference in this luminance difference, termed facial contrast. This is defined as the difference between the darkness of the eyes and the mouth (features) and the brightness of the skin, with females naturally possessing greater contrast than males. Also, females with higher contrasts were rated as more feminine, while men with lower contrasts were rated as more masculine. These findings were consistent across both Caucasian and Asian samples. A summary of the perceptual relevance of colour channels is shown in Table 1.

Table 1.

Illustration of CIELab colour channels and their perceptual relevance.

*L** channel light-dark	*a** channel red-green	*b** channel blue-yellow
Related to sex differences in skin lightness. Females have lighter skin than males, and possess greater contrasts in this channel (Russell, 2009).	Indicates good blood oxygen perfusion, linked with healthy circulation (Stephen et al., 2009). Higher levels of redness preferred for optimal health (Stephen, Law-Smith, et al., 2009).	Greater yellowness is linked with health in non human animals (Lozano, 1994). Linked with carotenoid consumption in humans and greater health (Stephen et al., 2011).
		

The application of cosmetics allow females to alter their facial properties in a multitude of ways. However, a typical cosmetics application, referred to as a 'received style' (Russell, 2010) follows a consistent pattern of increasing skin lightness whilst darkening the features, an effect observed across both cultures and historical accounts (Corson, 1972; Russell, 2010). This enhances precisely the sexual dimorphism identified by Russell (2009), which is unlikely to occur by chance alone - sexual dimorphism is attractive (Johnston & Franklin, 1993), and cosmetics act on dimorphic colour information. The application of cosmetics has several other positive effects on female faces. Females are seen as more attractive and competent (Etcoff, Stock, Haley, Vickery, & House, 2011) with cosmetics than without, an effect which increases with increasing amounts of cosmetics, and thus contrast (Etcoff et al., 2011). Furthermore, females are seen as more healthy with cosmetics than without (Nash, Fieldman, Hussey, Lévêque, & Pineau, 2006). This is unsurprising, given that cosmetics homogenise skin texture (Samson, Fink, & Matts, 2010), a key element of attractive skin. What kind of colour properties do cosmetics convey to contribute to these perceptions?

Some studies have examined the the contrasts particular features have with the rest of the face, and how this affects perceptions of sexual dimorphism and attractiveness. Stephen and McKeegan (2010) allowed participants to vary the contrast the lips had with the rest of the face across CIELab colour space. In females, darker lips were seen as more attractive, while redder lips were seen as more attractive and more feminine, properties easily obtainable through an application of cosmetics. Participants also found female faces with very low b^* contrasts attractive and more feminine, likely due to the fact the lips then have no blue colouration, a sign of respiratory illness (Ponsonby, Dywer, & Cooper, 1997). In males, darker, redder and slightly yellower lips were more sex typical as well as attractive, though much less so than in females. Further to this, Porcheron, Mauger, and Russell (2013) found that different feature contrasts (including the eyebrows) in females decline with age across different colour channels. Increasing these contrasts led to perceptions of youthfulness. If cosmetics are used correctly, they can theoretically correct for these age related declines.

The present study aims to answer two related questions concerning facial contrast and colour. First, are there sex differences in feature contrasts across CIELab colour space for the brows, the eyes, and the mouth? Previous research examining contrast has not included the eyebrows and has used grayscale rather than luminance information (Russell, 2009), or has examined contrasts in only one feature across colour channels between sexes (Stephen & McKeegan, 2010). We examine contrasts, rather than absolute colour values, for two reasons. Contrasts are dimorphic and contribute to attractiveness (Russell, 2009; Stephen & McKeegan, 2010). Moreover, the large sample of Caucasian and Asian faces we analyse were collected at different times and under different lighting conditions, so comparing absolute values would likely lead to erroneous conclusions. Additionally, since skin colouration varies greatly between ethnic groups, a cross cultural analysis of contrast will establish whether it is a genuine sex difference (Russell, 2009), present within and between ethnic groups. Second, what colour contrast changes does an application of cosmetics brings to a face? These changes may follow sexually dimorphic patterns across colour. Alternatively, any contrast changes resulting from cosmetics may alter other relevant colour properties, such as those related to health (Stephen, Coetzee, & Perret, 2011). Given the orthogonal nature of CIELab values, cosmetics may have different effects on different colour channels. To address these questions, a large collection of faces of both Caucasian and Asian individuals are subjected to contrast analysis, alongside a sample of females with and without cosmetics.

6.2 General Method

Across four sets of faces, (Sets 1A, 1B, 2 and 3) we calculated contrast for the eyebrows, eyes, and mouth, using CIELab colour space. We discuss the various photographic capture, methods, demographic information and analyses below, after discussing the procedure for analysing contrast.

6.2.1 Image analysis procedure

All images were landmarked using JPsychomorph (Tiddeman, Burt & Perrett, 2001). Image sets 1B and 2 were landmarked with a series of 179 landmarks, while sets 1A and 3 were delineated with a set of 160 points. The wealth of landmarks used in both templates offers a great deal of flexibility in defining regions of interest (ROI) to extract colour information, and we used MATLAB 7.9.0 (R2009b; The Mathworks Inc, Massachusetts) to define these around the eyebrows, eyes and mouth. We also created annuli around each of the features to capture skin colouration. For the eyebrow annulus, we utilised points that lay along the upper eyelid in addition to scaling the Y coordinates of points along the upper eyebrow by a factor of 0.5. For the eye annulus, we incorporated points along the lower eyebrow, points along the side of the nose bridge, points that approximated the periorbital skin under the eyes, and two points approximating the temple and zygion, scaled back by a factor of 0.5 on the Y axis. For the mouth, we simply expanded the lip ROI by a factor of two. These regions are illustrated in Figure 1.

Unlike previous studies examining contrast (Porcheron, Mauger, & Russell, 2013; Russell, 2009), we exclude the sclera from the eye feature, and instead define the eye feature as the iris, and the skin directly around the sclera, including the eyelashes. This is also highlighted in Figure 1. We do this for two reasons. First, humans have white sclera to signal eye gaze (Kobayashi & Koshima, 1997), resulting in a prominent area of high contrast within the eye feature. Averaging the values of the sclera and outer eye together ignores this, representing the feature as a perceptually uniform object. Indeed, cosmetics have been shown to impair perceptions of eye gaze (Ueda & Koyama, 2011), which suggests higher eye contrast causes the sclera to become less prominent. Excluding the sclera from calculations controls for this perceptual alteration. Second, there are no cosmetic practices that easily manipulate the sclera, while eyelashes and the skin immediately surrounding the eye are regularly modified.

We calculated the average luminance (L^*) pixel values of each eye feature before averaging those values to produce the mean eye feature luminance. This was repeated for the brows, as well as lip ROIs. Similarly, we averaged the mean luminance values from each eye and brow annulus, to produce mean annulus luminance, as well as averaging the pixels within the mouth annulus. We calculated contrast for each region using Russell's (2009) adapted Michelson contrast, which is as follows: C_{L^*} = (skin L^* - feature L^*)/(skin L^* + feature L^*). Values can range from -1 to 1, with positive values indicating the skin has a higher luminance value than the feature, while negative values indicate the feature has a higher luminance value than the skin. We repeated these calculations for each face for both the a^* (C_{a^*}; red-green) and b^* (C_{b^*}; blue-yellow) channels.

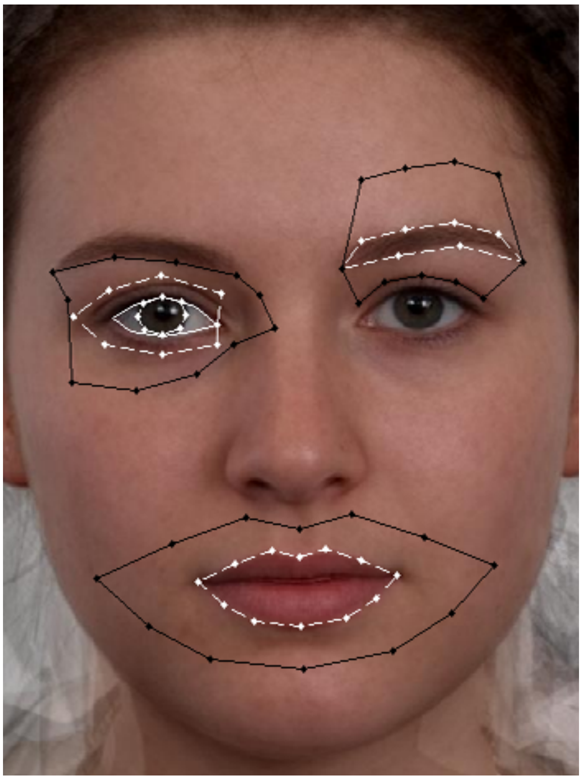

Figure 1. An illustration of the regions of interest used to extract colour information. Dashed white lines denote feature areas, while solid black lines represent annuli. Note the solid white line around the iris - pixels within this region, but not the iris, were excluded from the eye feature.

6.3 Experiment 1.1

Set 1A. Seventy-three females (age *M* = 21.37, *SD* = 6.25) and 43 males (age *M* = 22.43, *SD* = 5.53), who self reported their ethnicity as White, were photographed using a Canon EOS 5D MKII camera with professional diffused lighting and reflectors. Models were asked to adopt a neutral expression and look directly at the camera. Models removed all traces of facial cosmetics and jewellery, and tied their hair back from their face as necessary.

6.3.1 Results

Luminance Contrasts. We carried out a 3 (Contrast Source: Eyes, Brows, Mouth) x 2 (Sex: Female, Male) ANOVA to assess sex differences in contrast sources. We found a main effect of Contrast Source, $F(2, 228) = 45.50$, $p < .001$, $\eta^2_p = .29$, indicating general differences in luminance contrast across each sex. Brows ($M = .17$) had higher contrast than Eyes, ($M = .15$), which in turn had greater contrast than the mouth ($M = .11$). There was no main effect of Sex, $F(1, 114) = .07$, $p = .79$, indicating that over each source there were no differences between females and males. The significant interaction $F(2, 228) = 10.24$, $p < .001$, $\eta^2_p = .08$, indicated a sex difference in certain contrasts, which post-hoc comparisons revealed was driven by females having significantly higher Eye C_{L*} than males, $t(114) = 2.89$, $p = .005$, $r^2 = .07$, and males having significantly higher Brow C_{L*} than females, $t(114) = 2.27$, $p = .03$, $r^2 = .04$. There were no significant differences in Mouth C_{L*}, $t(114) = 1.03$, $p = .31$. Luminance contrasts across all image sets are illustrated in Figure 2.

Alpha Contrasts. Another 3 x 2 ANOVA revealed a main effect of Contrast Source, $F(2, 228) = 2327.36$, $p < .001$, $\eta^2_p = .95$. Across sexes, the average mouth C_{a*} ($M = -.05$) was lower than the very small red-green contrast of the Eyes ($M = .005$) and Brows ($M = .002$). The negative value of mouth contrast indicates the feature is redder than the surrounding skin, consistent with previous work (Stephen & McKeegan, 2010). There was a trend towards a main effect of Sex, $F(1, 114) = 3.78$, $p = .054$, $\eta^2_p = .03$. Again, there was a significant interaction, $F(2, 228) = 8.07$, $p < .001$, $\eta^2_p = .06$. Post hoc comparisons revealed this was driven by men having a greater C_{a*} for the Brows, $t(114) = 4.40$, $p < .001$, $r^2 =.15$.

Beta Contrasts. A further 3 x 2 ANOVA revealed another main effect of contrast source, $F(2, 228) = 65.79$, $p < .001$, $\eta^2_p = .36$. Across sex, Eyes ($M = .012$) and Mouth ($M = .010$) had similar yellow-blue contrast, with almost no C_{b*} around the Brows ($M = .002$).

There was no main effect of Sex, $F(1, 114) = 0.73$, $p = .39$, $\eta^2_p = .006$, but another interaction, $F(2, 228) = 4.31$, $p = .02$, $\eta^2_p = .04$. Post hoc analyses revealed the interaction was driven by women having higher C_{b^*} around around the Mouth, $t(114) = 2.99$, $p = .003$, $r^2 = .07$.

6.4 Experiment 1.2

Set 1B. One hundred and thirty four females (age $M = 21.24$, $SD = 2.88$) and 57 males (age $M = 21.42$, $SD = 3.45$), again who self reported their ethnicity as White, were photographed in an identical manner to Set 1A. Their contrasts were calculated using the same procedure.

6.4.1 Results

Luminance Contrasts. We carried out another 3 x 2 ANOVA examining Contrast Sources between Sex, and found a main effect of Contrast Source, $F(2, 228) = 160.02$, $p < .001$, $\eta^2_p = .46$. Again, Brows ($M = 27$) had greater luminance contrasts than the Eyes ($M = .23$), which were greater than the Mouth C_{L^*} ($M = .15$). There was no main effect of Sex, $F(1, 189) = 2.98$, $p = .09$, $\eta^2_p = .02$. However, there was an interaction between Contrast Source and Sex, $F(2, 228) = 29.72$, $p < .001$, $\eta^2_p = .14$. As before, this was driven both by females having greater Eye C_{L^*} than men, $t(189) = 3.95$, $p < .001$, $r^2 = .07$, and males having greater Brow C_{L^*} than females, $t(189) = 4.66$, $p <.001$, $r^2 = .10$.

Alpha Contrasts. A 3 x 2 ANOVA revealed a main effect of Contrast Source, $F(2, 378) = 3135.63$, $p < .001$, $\eta^2_p = .94$. As before, the average mouth C_{a^*} ($M = -.03$) was lower than the contrasts of the Eyes ($M = .01$) and Brows ($M = .02$). There was also a main effect of Sex, $F(1, 189) = 7.89$, $p = .005$, $\eta^2_p = .04$. Red-green contrasts were slightly lower across all sources in females (M = -.002) than males (M = .00). However, as before, the interaction between Contrast Source and Sex, $F(2, 378) = 36.37$, $p < .001$, $\eta^2_p = .16$, was driven by the Brow C_{a*} being higher in males than females, $t(189) = 6.46$, $p < .001$, $r^2 = .18$. Additionally, women had higher Eye C_{a*} than men, $t(189) = 2.21$, $p = .03$, $r^2 = .03$.

Beta Contrasts. A 3 x 2 ANOVA revealed a main effect of Contrast Source, $F(2, 378) = 217$, $p < .001$, $\eta^2_p = .53$. Eye yellow-blue contrast (M = .02) was greater than Brow (M = .008) and Mouth C_{b*} (M = .002). There was no main effect of Sex, $F(1, 189) = 2.31$, $p = .13$. A further interaction, $F(2, 378) = 21.78$, $p < .001$, $\eta^2_p = .10$, revealed men had greater Brow C_{b*} than women, $t(189) = 3.90$, $p < .001$, $r^2 = .07$.

6.5 Experiment 1.3

Set 2. Seventy-nine female (age M = 22.93, SD = 2.71) and 55 male (age M = 23.27, SD = 3.84) Asian individuals were photographed against a white background using a Nikon D3000 camera, with a flash angled towards the ceiling. Participants were asked to adopt a neutral expression and to remove all cosmetics and jewellery, and to tie their hair back from their face. Contrasts were calculated as above.

6.5.1 Results

Luminance Contrasts. As before, we carried out a 3 x 2 ANOVA examining Contrast Source between sexes. There was a main effect of Contrast Source, $F(2, 264) = 109.44$, $p < .001$, $\eta^2_p = .45$. As with our Caucasian samples, the light-dark contrast of the Brows (M = .17) was higher than Eye C_{L*} (M = .15) and Mouth C_{L*} (M = .12). There was also a main effect of Sex, $F(1, 132) = 9.35$, $p = .003$, $\eta^2_p = .06$, in which males had surprisingly higher C_{L*} in general ($M = .15$) than females ($M = .14$). As before, the interaction term was significant and followed a similar pattern to our previous samples, $F(2, 264) = 53.37$, $p < .001$, $\eta^2_p = .28$, and was driven similarly by higher Brow C_{L*} in males than females, $t(80.69) = 6.35$, $p < .001$, $r^2 = .26$. Additionally, females had greater Eye C_{L*} than males, $t(132) = 4.95$, $p < .001$, $r^2 = .16$. Mouth C_{L*} was higher in females than males in this set, $t(132) = 2.68$, $p < .001$, $r^2 = .05$.

Alpha Contrasts. A 3 x 2 ANOVA revealed a main effect of Contrast Source, $F(2, 264) = 3781.24$, $p < .001$, $\eta^2_p = .96$, in that the red-green contrast of the Mouth was lower ($M = -.04$) than Brow ($M = .02$) or Eye contrast ($M = .006$). There was a main effect of Sex, $F(1, 132) = 32.32$, $p < .001$, $\eta^2_p = .19$, in which females had overall lower C_{a*} than males ($M = -.009$, $M = -005$). This small difference is best understood by the significant interaction, $F(2, 264) = 42.69$, $p < .001$, $\eta^2_p = .24$, which was driven by males having greater Brow C_{a*} than females, $t(132) = 10.40$, $p < .001$, $r^2 = 45$.

Beta Contrasts. A final 3 x 2 ANOVA revealed a main effect of Contrast Source, $F(2, 264) = 255.64$, $p < .001$, $\eta^2_p = .65$, in that the yellow-blue contrast of the Brow was higher ($M = .03$) than Mouth ($M = .02$) or Eye ($M = .02$) C_{b*}. There was also a significant main effect of Sex, $F(1, 132) = 10.98$, $p = .001$, $\eta^2_p = .07$. This difference was again very small, with males having slightly higher overall C_{b*} than females, $M = .021$ to $M = .019$, respectively. The interaction term was significant, $F(2, 264) = 53.45$, $p < .001$, $\eta^2_p = .28$, and was driven by males having greater Brow C_{b*} than females, $t(132) = 8.57$, $p < .001$, $r^2 = 36$. Females also had marginally higher Eye C_{b*} than males, $t(132) = 2.04$, $p = .04$, $r^2 = .03$.

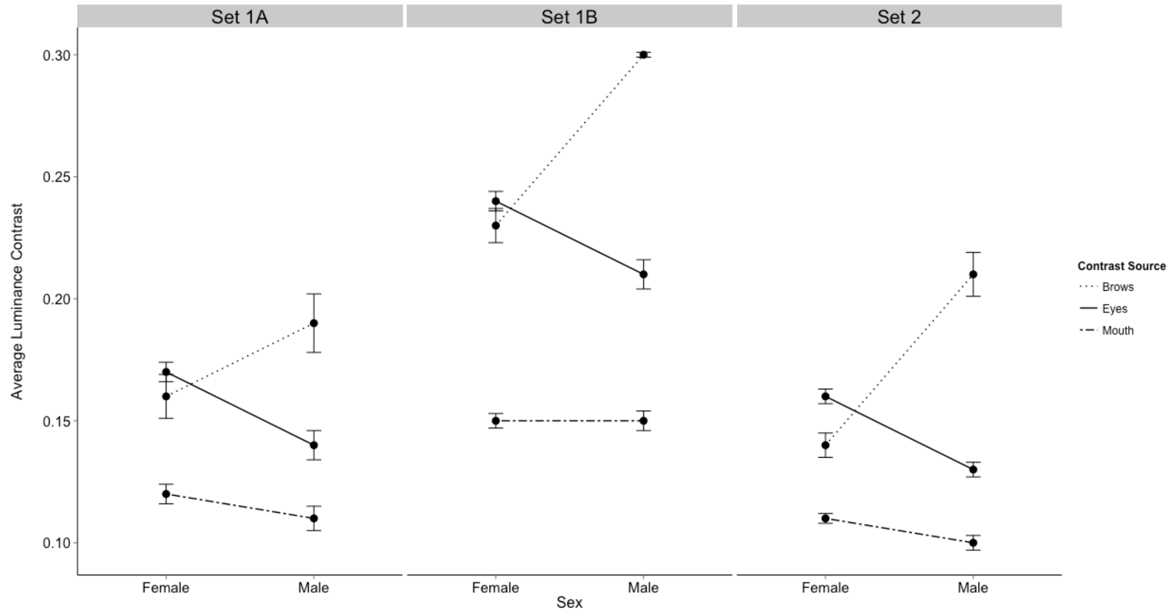

Figure 2. Average luminance contrasts across image sets and contrast sources. The pattern was clearly consistent across image sets for the eyes and brow, though the difference in mouth contrast was significant in Set 2, while in the Caucasian samples the mean differences were in the same direction. Error bars represent ±1 *SEM*.

6.6 Experiment 2

When women apply cosmetics, they achieve a greater level of overall facial luminance contrast, which enhances femininity (Russell, 2009). This centres around the differences in eye contrast, which we have shown is consistent across race. However, cosmetics serve to do more than enhance sexual dimorphism - women are perceived as more healthy after application (Nash et al., 2006), and often more attractive, competent and trustworthy (Etcoff et al., 2011). In the following experiment, we sought to examine the changes across feature contrasts after cosmetics were applied to establish whether patterns of sexual dimorphism are manipulated, or whether cosmetics increase desirable properties of skin colouration (Stephen et al., 2009; 2011). There is also the potential for the cosmetics to differentially affect colour channels, increasing sexual dimorphism in one channel, and accentuating healthy colouration in another, for example.

6.6.1 Method

Set 3. Forty-four females (age M = 21.18, SD = 1.94) posed as models. All self reported their ethnicity as White. Models removed all traces of cosmetics they were wearing, as well as any facial jewellery. They were then photographed, capturing their appearance without cosmetics. A range of popular cosmetic items were provided (lipsticks, blushers, foundations, mascaras and eyeshadows), and models were asked to apply cosmetics for a "night out" before being photographed again,. All photographs were taken with a Nikon D3000 camera against a white background, with standardised lighting from a flash angled 45º towards the ceiling. We calculated contrast using the same methods as above, both before and after cosmetics application.

6.6.2 Results

Luminance Contrasts. We carried out a 3 (Contrast Source: Eyes, Brows, Mouth) x 2 (Cosmetics: Without, With) ANOVA to examine changes in luminance contrasts between conditions. There was a significant main effect of Cosmetics, $F(1, 43) = 49.81$, $p < .001$, η^2_p = .54. As predicted, overall light-dark contrasts were higher in the With Cosmetics condition (M = .18) than Without (M = .16). There was also a significant main effect of Contrast Source, $F(2, 86) = 149.55$, $p < .001$, $\eta^2_p = .77$. Eye C_{L*} was higher (M = .26) than Mouth (M = .12) or Brow C_{L*} (M = .12). There was also a significant interaction between Cosmetics and Contrast Source, $F(2, 86) = 70.03$, $p < .001$, $\eta^2_p = .62$. Post hoc tests found this was driven by several differences. Eye C_{L^*} was significantly higher in the cosmetics condition, $t(43) = 9.84$, $p < .001$, $r^2 = .69$, as was Mouth C_{L^*}, $t(43) = 2.13$, $p = .04$, $r^2 = .09$. However, eyebrow C_{L^*} was significantly lower in the With Cosmetics condition, $t(43) = 3.47$, $p = .001$, $r^2 = .22$.

Alpha Contrasts. Another 3 x 2 ANOVA revealed a significant main effect of Cosmetics, $F(1, 43) = 29.79$, $p < .001$, $\eta^2_p = .41$. The Without Cosmetics condition had lower red-green contrasts ($M = -.014$) than the With Cosmetics condition ($M = -.010$). Again, there was a significant main effect of Contrast Source, $F(2, 86) = 756.95$, $p < .001$, $\eta^2_p = .95$. Eye C_{a^*} was higher (that is, skin was redder than the feature, $M = .014$), than both Brow ($M = -.007$) and Mouth C_{a^*} ($M = -.044$). The interaction term, $F(1, 43) = 71.07$, $p < .001$, $\eta^2_p = .62$, was driven by higher Eye C_{a^*} in the With Cosmetics condition, $t(43) = 14.04$, $p < .001$, $r^2 = .82$, as well as by Mouth C_{a^*} being lower in the Without Cosmetics condition, $t(43) = 2.38$, $p = .02$, $r^2 = .12$. To clarify, the skin surrounding the eye had higher redness than the feature, while the lips had higher redness than the surrounding skin.

Beta Contrasts. A 3 x 2 ANOVA revealed a further main effect of Cosmetics, $F(1, 43) = 92.73$, $p < .001$, $\eta^2_p = .68$. Overall, the With Cosmetics condition had higher C_b ($M = .02$) than the Without Cosmetics condition ($M = .01$). As before, the main effect of Contrast Source, $F(2, 86) = 262.14$, $p < .001$, $\eta^2_p = .86$, showed higher Eye yellow-blue contrasts ($M = .03$) than Mouth C_{b^*} ($M = .02$), while Brow C_{b^*} was very low ($M = -.006$). A final interaction, $F(2, 86) = 99.71$, $p < .001$, $\eta^2_p = .69$, was driven by higher Eye and Mouth C_{b^*} in the With Cosmetics condition, $t(43) =13.49$, $p < .001$, $r^2 = .81$, and $t(43) = 5.75$, $p < .001$, $r^2 = .43$, respectively. The changes across feature contrasts and all colour channels are illustrated in Figure 3.

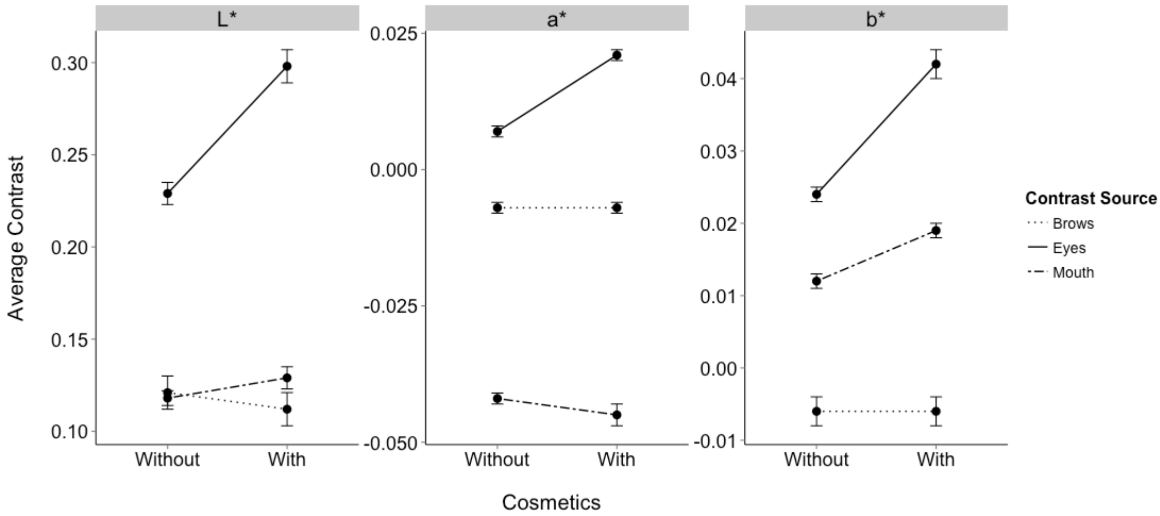

Figure 3. Changes in contrast before and after cosmetics application, across all colour channels. Error bars represent ±1 *SEM*.

6.7 Discussion

The present study addressed two issues. First, we examined sex differences in feature contrasts across three large and representative samples of faces, for each channel of the CIELab colour space. Second, we examined how application of cosmetics altered colour properties in the face, and whether these differences follow sexual dimorphisms in colour, or more general differences.

We found several novel and consistent findings about contrast across our image sets. Concordant with previous research (Russell, 2009), we found that females had higher eye luminance contrast than men, but that males have much higher brow C_{L*} than females, and that this was consistent across race. Heavier brows are considered a masculine, sexually dimorphic trait (Glassenberg, Feinberg, Jones, Little, & DeBruine, 2010), and a strong luminance difference likely contributes to such dimorphism. It also may go some way to explaining why women have various cosmetic practices regarding the eyebrows, such as reshaping and plucking, which would reduce contrast by removal of dark hairs.

We also found consistent differences when examining alpha contrast. Men possessed lower red-green contrasts around the brows, with the feature being redder than the surrounding skin. This is likely due to the brows being heavier, and having more hair coverage. There were less consistent results when examining the yellow-blue contrasts across samples. Consistently, males had higher contrast around the brows than women, but differed on little else. In Set 1A, males had lower mouth C_{b*} than females, though this finding was not replicated elsewhere. This may be due to an artefact of lighting, which was inconsistent across sets, rather than a real difference.

A finding from previous research (Russell, 2009) is that females have higher mouth luminance contrast that males, at least in Caucasian samples. We find the opposite here, in that Asian females possess higher C_{L*} around the mouth than males. Previous work has shown that Caucasian females do possess greater mouth contrast than males, but that this particular colour channel is not perceptually relevant when considering sex typicality, but is important to perceptions of attractiveness (Stephen & McKeegan, 2010). This may be due to the fact increases of C_{L*} are related to perceptions of health, a particularly important trait for females as it is more closely tied with attractiveness (Rhodes, Chan, Zebrowitz, & Simmons, 2003). Given the previous literature and our own findings, we conclude that a sex difference in mouth contrast is tentative at best, and that further work is needed to discern the difference. However, it is worth noting the cross cultural invariance in contrasts. There was remarkable consistency in the pattern of results between our Caucasian and Asian samples, with males having greater brow contrast across channels, and females having greater luminance contrast for the eyes. These results point to a subtle, but genuine sex difference in human skin colouration. Given the relationship skin correlation facial contrast shares with sex typicality (Russell, 2009), it is likely it also influences judgements of attractiveness cross culturally in the same way other colour properties reliably do (Stephen, Coetzee, & Perrett, 2011; Stephen, Coetzee, Law-Smith, & Perrett, 2009). Some studies demonstrate males prefer females with lighter than average skin within different ethnic populations (Hunter, 2002). Given such reliable sex differences in colouration, it is likely that contrast is linked with lighter skin, and is more preferred in female faces.

There were some findings that were inconsistent across image sets. In Set 1A, females had greater yellow-blue contrast around the mouth than males, and that in Set 1B females have higher red-green contrast than males. However, given the small amount of variance these results explain, and their inconsistency, it is likely they are the result of measurement noise or artefacts of lighting differences.

Across all of our samples and channels, there was a clear main effect of Contrast Source, whereby the brows were consistently the feature that displayed the greater contrast. This suggests that the eyebrows are a visually salient feature, perhaps more so than the eyes themselves. Indeed, some research shows that the removal of eyebrows significantly impairs face recognition (White, 2004), and that they may be more important in face recognition than the eyes themselves (Sadr, Jarudi, & Sinha, 2003).

The application of cosmetics resulted in changes in luminance contrast across all sources, with the largest effects around the eyes and brow. Cosmetics increased eye C_{L*}, but decreased brow C_{L*}. This alteration further diverges the sex difference in eye and brow luminance contrasts - eye contrast is enhanced, while brow contrast is attenuated. Mouth contrast also increased with the application of cosmetics, which is consistent with previous work (Russell, 2009). This increase in contrast also echoes previous findings in which greater mouth C_{L*} increases attractiveness for females (Stephen & McKeegan, 2010).

We found that cosmetics decreased the red-green contrast around the mouth, making it more negative. This reddening of the lips has been shown to correlate with femininity and attractiveness in females (Stephen & McKeegan, 2010). We also found that cosmetics increased C_{a*} around the eyes. This change was positive, indicating redder skin, likely achieved by cosmetic products such as eyeshadows, blushers or foundations applied near the eyes. Overall, the observed colour changes fit well with established colour properties important for healthy skin - brighter and redder facial features are more healthy (Stephen et al., 2009).

Yellow-blue properties in the beta channel were altered by cosmetics, increasing contrasts around the eyes and mouth. Skin with higher yellowness is perceived as more healthy and attractive (Stephen et al., 2009), which cosmetics seem to emulate. Interestingly, we found cosmetics increase mouth C_{b*}, but that this alteration is not perceived as sex typical for females, nor is it optimally attractive (Stephen & McKeegan, 2010). Why might these values be increased by cosmetics? The discrepancy may be offset by the increased yellowness of the skin, as well as the brighter and redder colour of the lips, which are both attractive colour properties (Stephen et al., 2009).

Facial cosmetics affect feature contrasts across colour channels differently. Our aim was to investigate what colour properties cosmetics change in faces, and whether these properties reflect sex differences in skin colouration, or act on other aspects of desirable colouration. We found that for luminance contrasts, cosmetics seem to enhance sex differences in the same colour channel. Cosmetics increase both eye and mouth contrast, while decreasing brow contrast, of which there is good evidence of dimorphism. For alpha contrasts, cosmetics increased the redness of the lips, and the redness of the skin around the eyes, both of which are related to health, attractiveness, and femininity (Stephen et al., 2009; Stephen & McKeegan, 2010). Furthermore, beta contrasts were positively increased around the eyes and the mouth, meaning the skin is yellower than the feature. Yellower skin is associated with health and carotenoid consumption (Stephen, Coetzee & Perrett, 2011), which, along with the other colour channel properties, may offset the fact the lips are bluer, which is linked to respiratory disease (Ponsonby et al., 1997).

We can also consider the different feature contrasts and how they change with age, and the role cosmetics might play in modifying these. Porcheron et al (2013) found that luminance contrasts decreased around the brow with age, as did the eyes, though to a lesser extent. Additionally, red green contrasts decreased around the mouth and eyes, while yellow-blue contrasts increased around the mouth with age. Our results with cosmetics show consistent analogies, in that contrasts increased around the eyes across each channel. Interestingly, models who applied cosmetics reduced eyebrow luminance contrast and increased eye yellow blue contrasts, as well as mouth red green contrasts, which decrease with age. However, they increased mouth yellow-blue contrasts, which increase with age. It is important to note our sample of females are young, and that cosmetics may serve different functions across different ages. However, at this stage, we can see that cosmetics do seem to act on some colour properties which alter with age.

In summary, we found that in women, the eyes have greater luminance contrast than males across races, but that male faces possess greater contrasts in all channels around the brows. We have also demonstrated that the application of cosmetics enhances sex differences in luminance contrast, as well as improving desirable colouration across all colour channels for the eyes and mouth. We conclude that cosmetics serve to manipulate both sexual dimorphisms and healthy colour properties, which may contribute to the observed boosts of femininity (Russell, 2009), health (Nash et al., 2006) and attractiveness (Etcoff et al., 2011) demonstrated in the literature.

CHAPTER 7: General Discussion

In this section of the thesis, I discuss several issues relating to the findings described in the experimental chapters, and tie them into the wider framework in the literature. Furthermore, I discuss potential applications of the research.

7.1 Kernels of truth in social judgements - further evidence

The second and third chapters of this thesis examined the central issue of accurately identifying social traits from the face, with a view to both determining what aspects of faces influence these judgements, and whether a typical application of cosmetics had any effect on this accuracy. Chapter 2 demonstrated that accuracy for personality traits is generally greater in the right side of the face, and was at chance for the left side. This is consistent with other findings that have examined judgements in accuracy from hemifaces (Kramer & Ward, 2011), which found the right side of the face afforded greater accuracy for the majority of personality traits in the Big Five model. Chapter 2 also demonstrated a dissociation in trait identification - physical health was detectable across all viewing angles equally well. These findings parallel other studies which have examined accuracy in composite faces (Kramer & Ward, 2010; Little & Perrett, 2007). However, the composites utilised in Chapter 2 were created in a significantly different way across a number of factors, and only two personality traits showed consistent identification (Agreeableness and Neuroticism) after controlling for postural variations present in two dimensional photographs. What might this mean? There is some evidence that demonstrates that individuals pose differently in different circumstances, and that this affects perceptions (Nicholls, Clode, Wood, & Wood, 1999; Lindell & Savill, 2010), and that head tilt can also affect perceptions of character (Mignault & Chaudhuri, 2003). Two dimensional composites suffer in that consistent postural cues along any axis adopted by the individuals are present in the composite. The reduction in accuracy we demonstrate here when removing as much postural information as possible points to a more dynamic account of social perceptions from the face associated with a class of controllable cues (Mazur, 2005). Concordantly, Leikas, Verkasalo and Lönnqvist (2012) asked models to pose different aspects of the Big Five, and had the subsequent photographs rated for personality traits by a large panel of observers. Though these observers saw the face as well as the torso of the model, the authors found accurate identification of Extraversion. We did not demonstrate accuracy for this trait in Chapter 2, but previously studies have demonstrated it via composites (Kramer & Ward, 2010; 2011; Little & Perrett, 2007; Penton-Voak et al., 2006). Furthermore, models were unable to successfully pose Agreeableness - something that showed accuracy even in our tightly controlled composites. Taken together, these findings suggest there may be more to perceptions of personality traits than previous work demonstrates. However, the dissociation between physical health, identifiable from any angle, and personality, more readily detectable from the right side of the face, is evidence that personality cues may be lateralised.

I also sought to examine the relative contributions of two major sources of information (outlined in Chapter 1) to the accurate identification of personality traits. For physical health, the most reliable source of information was skin texture, consistent with a growing body of literature (Stephen, Law-Smith, Stirratt, & Perrett, 2009; Stephen et al, 2011), which was also accurate across viewpoints. For the accurately detected personality traits, Agreeableness and Neuroticism, texture and shape were the more reliable cues, respectively. This suggests that faces may convey multiple messages through multiple channels, though this is certainly an avenue for future work.

One of the main criticisms of detecting personality traits in the face is that the majority of studies assess the question with composites. While composite faces are useful in representing average configurations, coupled with a two-alternative forced choice approach, it may be that people are able to only easily discriminate between high and low prototypical appearances of certain traits. Essentially, while there may be some information about our personality carried in our face, it may only become apparent when it is made obvious via a comparison of average high and low variations. Naturally, using individual faces is an ideal way to assess accuracy in a more ecologically valid way. Among the existing literature, only two papers assess accuracy using this method (Penton-Voak et al., 2006; Shevlin, Walker, Davies, Banyard, & Lewis, 2003), and with only Penton-Voak et al (2006) using a five factor model of personality. Therein, the authors found significant accuracy for Extraversion only in female faces. While we also found evidence for Extraversion, we additionally demonstrated accuracy for Openness and Emotional Stability. Given the similarities, it does seem that some information is readable from an individual face. However, Agreeableness was not detected, despite the relative prevalence of it in other work (Kramer & Ward, 2010; Little & Perrett, 2007). It is also intriguing that Leikas et al (2012) did not find evidence of Agreeableness in posed photographs. More conflicting evidence comes from Naumann, Vazire, Rentfrow and Gosling (2009), who demonstrated accurate identification of only Extraversion in a standardised, strictly controlled photograph (as is commonly used), but a wide range of accuracy across all Big Five traits when the models were allowed to pose in a natural manner.

Our findings in Chapters 2 and 3 both support and contradict these findings. With posture removed, people are unable to identify Extraversion, but maintain accuracy on other traits. When posture is not controlled, but minimised (through cropping and rotating images), we demonstrate accuracy of Extraversion, Openness, and Emotional Stability, traits which Naumann et al. (2009) show accuracy for in spontaneously posed photographs. However, the traits identified from posed photographs in Naumann et al (2009) were from full body poses, and dynamic cues such as clothing played a large role in accuracy. It is interesting to note the concordance between the results here and the literature on accuracy in faces, but the conflicting evidence from other areas. We rarely see faces in isolation, and so future work should examine the relationship between cues from the face and body.

Taken together, the findings of the current thesis support earlier work (Kramer & Ward, 2010; Little & Perrett, 2007; Penton-Voak et al., 2006) in that aspects of personality are readable from the static, neutral face. However, it does introduce some caveats to what traits are readily identifiable, particularly Extraversion, and points to a stronger role of dynamic cues (Mazur, 2005). Interestingly, the work in the current thesis showed consistent identification of Neuroticism and Emotional Stability. Coupled with the consistent identification of this trait elsewhere, these findings suggest it may be an easily detectable trait. Recently, we have examined whether observers can discriminate between high and low composites of individuals with depressive symptoms (Scott, Kramer, Jones, & Ward, 2013), finding accuracy for both composites and individual faces warped along shape and texture continuums. Indeed, Neuroticism levels can be used to predict later levels of depression (Roberts & Kendler, 1999), so the fact it is reliably detectable from the face hints at an influence of appearance on our behaviour. Moreover, Scott et al (2013) demonstrated observers perceive those with higher levels of depression as having less desirable social characteristics, suggesting our appearance mediates how others respond to us.

7.2 Cosmetics and social camouflage

Given the evidence of signals and cues to personality in the face, one of the questions this thesis sought to address was whether an application of cosmetics can alter signals or cues of personality in the face. More specifically, we wanted to see whether cosmetics could shift perceptions in a specific direction - towards the ideal personality of an individual. In the same way individuals can potentially portray themselves in any way using online profiles (Back et al., 2010), the use of cosmetics by females may reflect some form of self idealization in terms of personality appearance. However, we established that cosmetics did not change the accuracy of perceptions of actual personality between conditions. Though a null result, it offers some insight into the source of cues to personality traits in the face. If skin texture is altered via cosmetics, and there is no resulting difference in accuracy, then we might infer that signals originate from either shape or posture. However, we did find evidence of perceptual shifts towards ideal levels of Openness and Extraversion when cosmetics were applied - observers ratings altered with cosmetics for those traits in the direction of ideal personality. These findings imply cosmetics can be used by females to alter their facial appearance in such a way that observers see them as they would ideally like to be. Additionally, there may be some relationship between the use of cosmetics, the appearance of personality, and desire for mates. By appearing differently, females may be able to attract a mate with a similar personality to the persona the female is portraying. It is intriguing that Extraversion is a widely desired trait in partners, but that people only want a partner a few degrees more outgoing than themselves (Figueredo, Sefcek, & Jones, 2006). These findings complement the shifts we saw in actual and ideal personality, and the rating differences with and without cosmetics for Extraversion. Furthermore, the findings presented in Chapter 3 may go some way to explaining the differences in perceptions of social traits in some studies demonstrate when cosmetics are applied (Cash Dawson, Davis, Bowen, & Galumbeck, 1989; Etcoff, Stock, Haley, Vickery, & House, 2011).

7.3 The function of cosmetics and perceptions of social traits

The effect of cosmetics on perceptions, rather than accuracy of social traits, are relatively well studied. We sought to examine in Chapter 4 whether these perceptions are different for men and women, and in doing so, establish the function of cosmetics use. We found a consistent interaction across many social traits, in that male observers rated lower when cosmetics were applied, while females rated more positively. These findings cast doubt on the more conventional account of cosmetics use, in which females use cosmetics to enhance their appeal to mates (Buss, 1988), and instead pointed to an alternative account - females might use cosmetics for intrasexual competition. Females perceive those wearing cosmetics are more socially desirable. However, in doing so, male observers are not impressed, instead perceiving them as less socially desirable. An analogous behaviour in females is the desire for thinness. Consider that females in Western cultures often desire to be thinner, and a mere exposure to thin rivals causes dissatisfaction with their own body (Li, Smith, Griskevicus, Cason, & Bryan, 2010). Indeed, Faer, Hendriks, Abed and Figueredo (2005) suggest that intrasexual competition for mates is a strong predictive factor of eating disorders such as anorexia and bulimia. However, males prefer a fuller figure (Fallon &

Rozin, 1985) for specific evolutionarily based reasons, like fecundity and health (Singh, 1993). Indeed, in times of economic hardship, females spend more on cosmetics than would otherwise be expected, presumably to compete for mates (Hill, Rodeheffer, Griskevicus, Durante, & White, 2012), by embodying desirable facial attributes in the same way thinness supposedly embodies desirable body attributes. Furthering this idea, I explored the effects of cosmetics more directly on attractiveness in a sample of both younger and older models, as well as a set of older and younger observers, to examine these sex differences across time. We can assess whether cosmetics serve a similar function in a sample of females who we might assume do not compete. Our findings there were similar, though not specifically concordant. In general, males found cosmetics less attractive across any age group, while females of any age were generally unaffected by cosmetics, apart from when older females were rating younger models. We might cautiously interpret this as a form of intrasexual competition between older and younger females. However, males still rated lower with cosmetics than they did without, an especially surprising finding in the older age group of males, who we might expect to prefer more attractive, younger males (Buss & Schmitt, 1993).

From this, there are two main findings. First, female observers ascribe more positive social traits to those wearing cosmetics, but interestingly do not alter their attractiveness judgements. This might be due to psychological mechanisms regarding self and other perceptions - since females use cosmetics almost exclusively (Etcoff, 1999), they may be more aware of the beautifying effects on faces, and when considering attractiveness, are able to mentally alter perceptions, negating the effects. Second, the use of cosmetics by females seems to consistently fail to impress upon males for any social traits or attractiveness. The findings from the second experiment of Chapter 4 offered some insight towards the reasons for this, in that optimal levels for perceptions of Femininity were lower for male observers than they were for females, but also vastly lower than the actual amount of cosmetics worn by the models. However, these findings conflict with a small but fairly consistent body of research, which demonstrates that when viewing faces with cosmetics, the sexes tend to agree on the effects of cosmetics (Nash, Fieldman, Hussey, Lévêque, & Pineau, 2006), or demonstrate males finding faces with cosmetics as more socially desirable or attractive (Cash et al., 1989; Mulhern, Fieldman, Hussey, Lévêque, & Pineau, 2003; Osborn, 1996).

Why are our results so different? In all of the above studies aside from that of Cash et al. (1989), the cosmetics were applied by a makeup artist. This is desirable from a methodological viewpoint as it greatly reduces inter-individual variance in cosmetics application, offering a a degree of standardisation over a highly personal behaviour. However, it is this inter-individual variance that is of interest - males may have found the faces with cosmetics as significantly more attractive as the cosmetics were applied by an individual trained to best improve an individuals appearance with cosmetics. This is relatively unsurprising, but the vast majority of females do not have a makeup artist apply their cosmetics on a day to day basis. We are interested in how any individual female might alter her own appearance, and whether they are, on average, effective in altering perceptions. Furthermore, the studies by Mulhern et al (2003), Nash et al (2006), and Osborn (1996), used a particularly small sample of face stimuli - ten, four, and five, respectively. It may well be that a small sample of faces that are adorned by a makeup artist lead to imprecise results in the perceptions of faces with cosmetics. Cash et al (1989) used a between groups design, akin to the procedures employed in Chapter 4, and used a much more representative sample of faces. The models in this sample additionally applied their own cosmetics, so the reader might consider it a closely matched design to that of Chapter 4. The female observers in the Cash et al. (1989) were unaffected by cosmetics application, but a significant interaction was driven by male observers affording higher ratings to faces with cosmetics. These findings share similarities only with Experiment 3 of Chapter 4, in which female observers were generally unaffected by cosmetics. So why do the males in our studies differ from the males in other, analogous studies?

7.4 The 'cosmetics penalty'

The evidence so far suggest that for female observers, cosmetics serve to increase perceptions of social desirability, but not attractiveness. Male observers consistently rate higher for social desirability as well as attractiveness for faces without any cosmetics, and where cosmetics are applied, prefer less than females do for attractive traits such as femininity. The findings from female observers point towards the account proposed by Hill et al (2012), which suggest cosmetics are used by women to compete intrasexually for mates. How do we reconcile the findings from male observers, who show markedly different results from an established norm (Buss, 1988; Cash et al., 1989)? It would be easy to dismiss the differences in findings as nuances of methodological differences, such as small sample sizes (Osborn, 1996) or the use of a makeup artist to apply cosmetics (Nash et al., 2006). The findings in Chapter 5 go some way to explaining why cosmetics do not work for males, and further compound why females use cosmetics.

In Chapter 5, with the attractiveness judgement placed in clear context, I found that female and male observers agreed on what constituted an attractive amount of cosmetics.

However, when considering what other females would find attractive, observers of either sex estimated a significant increase over their own preferences. Beyond this, female observers estimated males to desire a further increase of cosmetics. This is fairly unsurprising, and demonstrates that females might wear the amount of cosmetics they do for males, as they believe males prefer such an amount. What *is* surprising is that this assumption is incorrect. Male observers prefer faces with less cosmetics, and this amount is what female observers consider looks most attractive themselves. What was more surprising was that male observers shared the same idea about *other* males that females do - that they prefer greater levels of cosmetics for optimal attractiveness, rather than the same amount of cosmetics that males individually prefer. This attitude may compound the notion for females that males prefer more cosmetics.

The findings from this study shed some light on why we observe such discrepant findings in Chapter 4. The issue is not cosmetics itself, but rather, quantity of cosmetics - since the actual amount of cosmetics worn by the models is in excess of even the highest estimates, we might predict the penalty male observers added was because of this. The ratings of faces without cosmetics are likely not inflated compared to those made with cosmetics, but rather reflect normal faces which excessive cosmetics induce a decrease. This ‘cosmetic penalty’ effect is related to the negative side of the halo effect, discussed in Chapter 1. There, I mentioned that more attractive females are seen as likely to be promiscuous and self centred (Dermer & Thiel, 1975), and more cold and selfish (Ashmore, Solomon, & Longo 1996). Previous research has demonstrated more cosmetics are detrimental to certain perceptions (Etcoff et al., 2011). Cox and Glick (1986) showed that varying amounts of cosmetics had little effect on femininity beyond an initial post-application increase, but found that, for gender stereotyped roles (in this case, secretarial work), greater amounts of cosmetics negatively affected expected performance. These findings are similar to those observed in Chapter 4, but without the context applied by Cox and Glick (1986). Huguet, Croizet and Richetin (2004) demonstrate further evidence of a ‘cosmetics penalty’. For young models (equivalent to the sample used in the majority of the current thesis), an application of cosmetics facilitated negative attributions - models were seen as more likely to be unfaithful, more shallow, dishonest, and less intelligent. Furthermore, the models in Huguet et al. (2004) had their cosmetics rated as somewhat excessive. Though this thesis has not explicitly tested such perceptions, the findings from Experiment 2 in Chapter 4 and the findings in Chapter 5 show that when people are free to vary the amount of cosmetics on a face, they consistently use less than the amount used by the model, offering some form of reconciliation of these findings. The results of Huguet et al (2004) differ from the current thesis in that they used a makeup artist to apply cosmetics to models. It is particularly interesting that self applied cosmetics, presumably idiosyncratic to each individual, results in a similar finding - cosmetics can result in negative perceptions, and wearers undergo a ‘cosmetics penalty’.

A possible caveat is that it is the attractiveness of the models themselves that lead to different impressions, and differential effects of cosmetics. Were this the case, we would really be examining the halo effect (Dion & Berscheid, 1972), rather than any effects of cosmetics. Perhaps a more attractive female serves to benefit less from cosmetics compared to a female of average attractiveness. The analysis of covariance in Chapter 5 revealed no effect of physical attractiveness, nor did the analyses by Huguet et al (2004). This holds true for many personality judgements as well - Kramer and Ward (2010) demonstrated no effects of physical attractiveness on the ability to discriminate personality composites, nor did Penton-Voak et al. (2006).

As demonstrated, the use of cosmetics does not always lead to more positive perceptions, and this is especially true for male observers. The evidence discussed above, and the findings from Chapter 5, illustrate this is likely due to several reasons. First, females seem to be wearing cosmetics to appeal to the mistaken ideal that more cosmetics is more attractive to males. However, this cosmetic look results in negative evaluations by male observers who see the models as generally less socially desirable than they would if they were not wearing cosmetics, a finding mirrored by others (Huguet et al., 2004). Though relatively unexplored, it is possible males see the use of cosmetics as signalling or cueing sexual receptiveness or unfaithfulness, as suggested by Huguet et al (2004). Depending on their sexual strategy (Buss & Schmitt, 1993), such signals or cues may be off putting or attractive. This poses an interesting question that may reconcile the findings of Huguet et al (2004) and the current thesis with more conventional findings (Cash et al, 1989; Etcoff et al., 2011) - does the sociosexual orientation (Penke & Asendorpf, 2008) of a male influence the amount of cosmetics he finds optimally attractive? It may be that the samples obtained herein are of individuals with low SOI's, and thus they find less cosmetics more optimal, as this reduces the cosmetics penalty.

7.5 Alternative explanations for perceptions

Another possible caveat with the current thesis is that the results may be based around an unusual application of cosmetics, or that our cosmetics instructions were limited to a "night out" application. There exists great variance in the way an individual female could apply cosmetics, and the use of a makeup artist reduces this variance (Cash et al., 1989). We attempted to strike a balance here by providing a range of cosmetic products that were best sellers the month before stimulus collection took place. These could be considered the "average" cosmetics product choice around that time, so it is reasonable assumption that the products supplied met at least some demands of the models, albeit with a degree of error. Further supporting this, the findings of Chapter 6 demonstrate no unusual findings post cosmetics application - female faces increased their luminance contrast around the eyes and mouth, and as demonstrated, decrease eyebrow contrast - a sexually dimorphic feature. These findings follow the typical style laid out by Russell (2010), and mirrors other work on facial contrast (Russell, 2009).

A possible and interesting explanation is that perceptions differ by the application of cosmetics *themselves*, rather than an alteration of the colour properties described in Chapter 6. I refer to, for example, the unnatural sheen of lip cosmetics or the shadows created by eyeshadows. It would be relatively easy to manipulate the contrast of facial features along a defined continuum (e.g., Stephen & McKeegan, 2010), inducing a relatively natural change in feature contrasts. It may be that the appearance of cosmetics is what causes such perceptions, as it is a cue to grooming behaviour. This cue informs others an individual has taken time on her appearance, which, contrary to the idea that 'what is cared for is good' (Graham & Jouhar, 1981), may compound on negative perceptions associated with attractiveness, such as vanity (Ashmore, Solomon, & Longo, 1996) or a self centred attitude (Dermer & Thiel, 2004). Relatedly, more attractive women use more cosmetics as a tactic to attract mates (Singh, 2004), and the association between cosmetics and promiscuity or vanity may be a cultural stereotype. An interesting comparison would be to obtain ratings of social traits of females with applied cosmetics, and a computer manipulation of facial contrast on the same face. In this way, we might separate the effects of increased femininity and attractiveness which is correlated with contrast, and the effects of cosmetics themselves on facial contrast.

Furthermore, the different perceptions observed in Chapters 4 and 5 may be attributable to different social groups. For example, Huguet et al. (2004) demonstrated differential effects of cosmetics on attractiveness depending on the degree the observer was enrolled in - aesthetic students (beauty therapy, etc) reacted more positively to cosmetics use than others. This could explain the positive reaction of females to faces with cosmetics in Chapter 4, as the observers were of the same cohort as the models, and likely share similar beliefs and ideals.

We might consider individual preferences in attractiveness as an alternative explanation. Though there is wide agreement on what constitutes an attractive face (Cunningham, Roberts, Barbee, & Druen, 1995), there still exists individual preferences (Kościński, 2008). Might these individual preferences be responsible for the different perceptions seen through Chapters 4 and 5? This could be the case, but the evidence presented here demonstrates good consistency across social traits and the age of the observer. Chapter 5 illustrates an agreement between males and females for optimal attractiveness, while Chapter 4 shows consistent agreement for Health judgements. However, females do estimate higher levels for Femininity than do males, which is reflected by the female observers in Chapter 5, who feel other females prefer more cosmetics than male ideas of other female preferences. Interestingly, though we show general agreement for optimal cosmetics for different appearances (attractiveness and health), the amount of cosmetics differs therein, suggesting differing amounts of cosmetics for different appearances - for example, less for health, but more for attractiveness. This supports the notion that health and attractiveness in faces are distinct appearances (Kalick, Zebrowitz, Langlois, & Johnson, 1998), and is certainly an important direction for future work.

7.6 Applications and conclusion

The experiments in this thesis were carried out with the questions of a cosmetics industry partner in mind, and as such, are directly relevant for the industry at large. Therefore, I summarise the findings here, and conclude the thesis.

The human face is undoubtedly a powerful predictor our behaviour towards others, from whom to ask for directions to who to ask out on a date. This thesis has demonstrated that aspects of our facial morphology, which is relatively unchangeable, plays a role in signalling aspects of our character to others. Furthermore, the qualities of our skin are particularly important in signalling aspects of physical health. However, the face is more than the sum of its parts - when shape and texture cues are combined, they convey more information than they do alone. The perception of personality also seems localised to the right side of the face, as demonstrated here and elsewhere (Kramer & Ward, 2011).

A reasonable assumption is that cosmetics might alter the ability of observers to correctly perceive personality in the face. The reader might imagine product claims originating from such an assumption - for example, certain cosmetics products to make an individual appear more outgoing, or friendly. However, given the evidence in Chapter 3, an application of cosmetics does little to alter accuracy in personality detection. It does offer some shifts of perceptions towards ideal levels of Extraversion and Openness. These effects are statistically significant, but the absolute effect sizes are extremely small. An interesting possibility not pursued here is the alteration of the right side of the face with cosmetics in subtle ways - an asymmetrical application may result in shifts in a desired direction, such as appearing more friendly, or more relaxed. This may be difficult to achieve in practice, however.

More promising insights stem from Chapters 4, 5 and 6. Chapter 4 demonstrates cosmetics holistically alter perceptions of social traits, depending on the sex of the observer - a simple application is either beneficial for female observers, or more negative for male observers, and this applies across the majority of cosmetic product consumers and general observers. As Chapter 5 illustrates, this is likely a quantity issue - simply, females are wearing too much makeup for the preferences of others, but they are doing it likely to appeal to the preferences of males. These findings, I believe, are of particular import to the cosmetics industry. By revealing that males are genuinely uninterested and even put off by the amount of cosmetics females wear, and, critically, share relatively the same idea of optimal amounts as females wear, those inclined to do so could engineer a new line of cosmetic insights for appearing optimally attractive. Though I would caution that further research needs to be done, I believe this a crucial insight.

Chapter 6 demonstrated the differences between males and females in terms of facial skin colouration, and how females alter their own contrast colouration with cosmetics. This highlights further insights - females naturally have lighter feature contrasts than males around the eyebrows. At the time of writing, a popular cosmetic trend in Western culture involves an application of cosmetics to the brow region, giving rise to clearly demarcated and often darkened eyebrows. Our results here suggest this practice may lead to conflicting perceptions of masculinity as well as femininity. We additionally demonstrated that the CIELab colour changes associated with an application of cosmetics mirror those skin properties associated with a healthy and attractive appearance. Of course, the optimal amount will vary for any given individual (Stephen, Coetzee, Law-Smith, & Perrett, 2009), but it is entirely possible to tailor different products to different skin tones in terms of CIELab values.

The main goals of this thesis were to further investigate the the perception of personality from the face, where those signals might lie, and to examine the effects of cosmetics on the perception of social traits. The research presented herein has succeeded in these goals by identifying the separate contributions of shape and texture to personality identification, and how cosmetics can shift this accuracy. Additionally, the work here demonstrates novel information about the effects of cosmetics on social attributions, and the low level effects of cosmetics on facial appearance.

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Appendix

Means and Standard Deviations for all results, Chapter 2

Trait	View	Information Source	M	SD
Agreeableness	Left	Combined	0.50	0.20
		Shape Alone	0.46	0.14
		Texture Alone	0.58	0.17
	Front	Combined	0.64	0.20
		Shape Alone	0.60	0.19
		Texture Alone	0.59	0.17
	Right	Combined	0.63	0.22
		Shape Alone	0.55	0.16
		Texture Alone	0.56	0.18
Conscientiousness	Left	Combined	0.52	0.16
		Shape Alone	0.51	0.16
		Texture Alone	0.51	0.17
	Front	Combined	0.53	0.22
		Shape Alone	0.48	0.18
		Texture Alone	0.52	0.15
	Right	Combined	0.45	0.18
		Shape Alone	0.45	0.18
		Texture Alone	0.51	0.17
Extraversion	Left	Combined	0.47	0.20
		Shape Alone	0.47	0.17
		Texture Alone	0.54	0.18
	Front	Combined	0.53	0.22
		Shape Alone	0.53	0.19
		Texture Alone	0.56	0.15
	Right	Combined	0.55	0.19
		Shape Alone	0.51	0.17
		Texture Alone	0.61	0.18
Neuroticism	Left	Combined	0.56	0.20
		Shape Alone	0.61	0.17
		Texture Alone	0.53	0.17
	Front	Combined	0.64	0.19
		Shape Alone	0.62	0.18
		Texture Alone	0.60	0.19
	Right	Combined	0.66	0.21
		Shape Alone	0.56	0.16
		Texture Alone	0.59	0.17
Openness	Left	Combined	0.50	0.18
		Shape Alone	0.47	0.17
		Texture Alone	0.51	0.18
	Front	Combined	0.52	0.21
		Shape Alone	0.49	0.16
		Texture Alone	0.51	0.18
	Right	Combined	0.50	0.24
		Shape Alone	0.51	0.19
		Texture Alone	0.52	0.16
Physical Health	Left	Combined	0.64	0.19
		Shape Alone	0.56	0.16
		Texture Alone	0.58	0.19
	Front	Combined	0.65	0.23
		Shape Alone	0.59	0.19
		Texture Alone	0.64	0.20
	Right	Combined	0.66	0.20
		Shape Alone	0.53	0.14
		Texture Alone	0.62	0.19