The role of body posture in perceptions of attractiveness and self-esteem

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Abstract

Attractiveness is hypothesised as a mechanism for identifying healthy, fertile mates, with cues from faces and bodies to physiological and psychological health. Little is known about the impact of body posture on attractiveness. Participants (*N*=108) were photographed twice in profile in their natural and corrected posture, and completed a validated self-esteem questionnaire using three scales from the International Personality Item Pool (IPIP, 1992/2017): The Physical Attractiveness (Rational Scale; IPIP, 1992/2017; Goldberg et al., 2006), the Self-esteem scale (IPIP, 1992/2017; Rosenberg, 1965), and the Self-Consciousness (IPIP, 1992/2017; Buss, 1980) scale, In addition, the State Self-Esteem Scale (Heatherton & Polivy, 1991) was administered. In Study 1, a correlational design, 38 observers rated the attractiveness of the natural posture photographs. Those whose natural posture was more upright were perceived as more attractive and higher self-esteem. A mediation analysis ascertained whether posture mediated the relationship between attractiveness and self-esteem, and showed that self-rated self-esteem predicts rated attractiveness and rated self-esteem as well as posture predict perceived self-esteem and attractiveness. The indirect effect of self-rated self-esteem on perceived attractiveness via posture was not significant. In Study 2, an experimental design, 41 observers completed a forced-choice task, choosing upright posture as more attractive and higher self-esteem. However, people who have higher self-esteem do not stand more upright. Therefore, posture is probably not a valid cue to self-esteem. Possible explanations for the perception of upright posture as attractive and high in self-esteem are discussed.

Declaration of Originality

Statement of Candidate

I hereby confirm that all material contained in this project are my original authorship and ideas, except where the work of others has been acknowledged or referenced. I also confirm that the work has not been submitted for a higher degree to any other university or institution. The research project was approved by the Macquarie University Human Research Ethics Committee (Approval No. 5201700990 and 5201810893819).

Signed:

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1. Introduction

Perceptual judgement of people's physical appearance has been widely studied by researchers over the past few decades (Little, Jones, & Debruine, 2011). People's tendency to make inferences from others' appearance is reflected in day to day sayings, for example 'love at first sight' or 'don't judge a book by its cover'. Perceptual cues include faces, bodies, and demeanour. People make swift judgements about attractiveness, health, mental state, and personality. These cues are perceived very quickly and subconsciously, often in 30 to 150 milliseconds (Anokhin et al., 2006). For example, a person forms judgements about an unfamiliar individual's health, youth, mental stability and other traits, thus subconsciously influencing the perception of the stranger's attractiveness and/or trustworthiness (Todorov, 2008; Willis & Todorov, 2006).

Research has investigated the cues that are used to form these subconscious judgements, and has mostly focused on cues obtained from faces (e.g. Stephen, Coetzee, & Perrett, 2011). In bodies, research has primarily focused on body-size (e.g., Stephen & Perera, 2014), shape such as waist-to-hip ratio (Swami, Jones, Einon, & Furnham, 2009), and lumbar curvature in women (Lewis, Russell, Al-Shawaf, & Buss, 2015). Further studies have investigated the effect of gait and movement on perceptions of emotion, attractiveness and masculinity (e.g. Thoresen, Vuong, & Atkinson, 2012). However, while the implications of posture for physical health are well known (e.g. Ishikawa et al., 2017), the role of body posture as a cue to underlying physiology and psychology, and its association with attractiveness, are less well studied.

Previous studies have suggested links between posture and underlying psychological state. Several studies have explored the relationship between posture, mental and emotional states. For example, one study (Brinol, Petty, & Wagner, 2009) proposed that posture can

influence self-evaluating thoughts. A slouched posture versus a straight posture changed the level of confidence participants were experiencing in their thoughts. Another study investigated the role of posture on stress responses and found that maintaining an upright posture helped participants to better deal with a stressful task (Nair, Sagar, Sollers, Consedine, & Broadbent, 2015). Other studies investigated cues to emotions, such as anger or fear, that people perceive from others' posture (Kleinsmith & Silva, 2006; Meeren, van Heijnsbergen, & de Gelder, 2005). The results indicate that people can accurately identify emotion from postural displays, and cross-cultural studies indicate broad agreement across cultures (Kleinsmith & Silva, 2006). Emotion cues from body posture might even override facial cues when they display conflicting emotions (Meeren et al., 2005). However, the relationship between a healthy body posture and self-esteem has not been examined.

1.1 Perception of traits from physical appearance

Darwin's theory of sexual selection posits that preferences for, and competition over, mates influences evolution (D. M. Buss, 1994). For humans, it is important to choose a mate carefully to ensure reproductive success (D. M. Buss & Schmitt, 1993). Specifically, it is vital to choose a healthy, fertile mate to avoid the spread of diseases and pathogens, and to enhance one's chances of producing healthy offspring (D. M. Buss & Schmitt, 1993). For men, it would be advantageous to mate with young, healthy, and fertile females, whereas for women, it would be valuable to find a partner, who is healthy, and has the physical ability and resources to look after her and her children (Symons, 1979). Thus, the underlying mechanisms of evolutionary selection influence what humans find attractive in a mate (D. M. Buss & Schmitt, 1993). In particular, there is significant agreement among researchers that people across cultures use similar cues to perceive attractiveness in faces (Langlois et al., 2000). Research with neonates and young infants indicates that there might be an innate

knowledge about the attractiveness of faces. For example, 3-month and 6-month old infants showed more interest in adult-rated attractive images than non-attractive images of faces, which suggests that infants may possess an aesthetic sense for faces similar to adults (Samuels & Ewy, 1985). This ability contradicts the popular notion that attractiveness is purely a learned concept, influenced by media and caregivers (Langlois, Roggman, Casey, Ritter, & Rieser-Danner, 1987).

Not only can infants differentiate attractive faces from unattractive ones, research exploring the topic cross-culturally showed that most cultures have similar criteria for the attractiveness of faces. Several characteristics of human faces are perceived as attractive regardless of the cultural background of the perceivers. These are symmetry, averageness, and sexual dimorphism, and, to some extent, skin colour (Coetzee, Perrett, & Stephen, 2009; Han et al., 2018; Little et al., 2011; Rhodes, Yoshikawa, et al., 2001; Stephen et al., 2011; Thornhill & Gangestad, 1999). It is an important aim to establish the universality of attractiveness and examine its evolutionary roots. However, another aspect in understanding evolutionary success is to ascertain whether attractive face and body cues represent valid cues to physiological and psychological health, and not simply a perceptual bias of the observer (Kalick et al., 1998). The idea of attractiveness as a cue to health is based on the ‘good genes’ hypothesis originally suggested by evolutionary biologists (Andersson, 1994). It states that general health and freedom from parasites is cued by shiny feathers or lustrous fur on animals, and such animals are the preferred mating partners to produce the best possible offspring (Andersson, 1994). However, the ‘good genes’ hypothesis fails to account for the development of large, cumbersome and seemingly disadvantageous traits, such as the peacock’s tail. The ‘handicap’ hypothesis proposes that only strong and healthy animals can afford to grow a seemingly disadvantageous feature, for example, large antlers or a heavy set of bright feathers, and still survive in good condition (Hamilton & Zuk, 1982). Therefore,

animals will prefer to mate with those that possess large, brightly coloured ornaments, since they represent 'honest signals' of quality. In addition, Hamilton and Zuk (1982) suggest an extension of the handicap hypothesis to the 'immunocomptence handicap' hypothesis. It posits that the display of heavy ornaments in male animals comes at a cost, because it is due to a heightened level of testosterone, which suppresses immune function. Only very strong and healthy animals can afford these increased testosterone levels, and still fight off pathogens (Hamilton & Zuk, 1982). Evolutionary psychologists have attempted to investigate the sexual selection link between attractive features and health in humans following the 'good genes' and the 'immunocompetence handicap' hypotheses (Thornhill & Gangestad, 1999). Some studies have therefore tested whether individuals who were rated as attractive are also healthy (e.g. Coetzee et al., 2009). However, when considering health in humans, both aspects of health, physiological and psychological health, need to be included.

1.2 Facial cues to attractiveness and physiological and psychological health

Researchers have examined different cues that make faces attractive, such as averageness, symmetry, skin colour, and facial adiposity (Coetzee et al., 2009; Coetzee, Re, Perrett, Tiddeman, & Xiao, 2011; Kalick et al., 1998; Lee et al., 2016; Rhodes, Zebrowitz, et al., 2001; Stephen et al., 2011; Thornhill & Gangestad, 1999). Various attractive features could function as valid cues to health. A 'valid' cue to health is a cue that is both perceived as healthy/attractive and reflects some aspect of underlying physiological or psychological health (Scott-Phillips, 2008).

Average faces are rated as attractive both cross-culturally, and by infants and adults alike (Thornhill & Gangestad, 1999). Average faces are closer to the population average, i.e. they have more typical appearance than distinct features (Rhodes, Yoshikawa, et al., 2001). Facial averageness is thought to stem from genetic heterozygosity, which is associated with

better resistance to pathogens and parasites, as well as providing optimal functionality, for example for breathing and chewing (Rhodes, 2006; Thornhill & Gangestad, 1999). However, studies that tested averageness show only weak links to health or none at all (Rhodes et al., 2001). These results suggest that averageness, whilst perceived as attractive and healthy, may not be a valid cue to health. Distinctiveness of faces and facial anomaly on the contrary, have been associated with genetic defects and developmental disorders (Zebrowitz & Rhodes, 2004), and could therefore more likely function as a valid cue to health (or the absence of health).

Recently, a study explored whether averageness is heritable, which had been previously assumed but not formally tested (Lee et al., 2016). The study detected a genetic component for facial averageness, which is important for the 'good genes' hypothesis (Lee et al., 2016). However, the authors point out that it only explains 24% of the variance. While this is usually considered a relatively large effect size (Field, 2013), it still suggests a considerable role for environmental and developmental factors, and measurement error, and the authors suggest that any conclusions should be made cautiously (Lee et al., 2016).

Symmetry is another aspect of facial attractiveness that has been tested whether it is a valid cue to physiological and psychological health. Similar to averageness, it is hypothesised that an individual who experiences developmental and environmental challenges, such as exposure to pathogens and infectious diseases, might reflect this in their facial appearance with minor deviations from perfect symmetry, called fluctuating asymmetry (Perrett et al., 1998). Rhodes et al. (2001) reported that symmetry is perceived as healthy but does not correlate with actual health data in a sample of 316 participants. Moreover, a study with a large cohort of children has not found a connection between high symmetry and good health in childhood longitudinal health records (Pound et al., 2014). However, another study found a

connection with Socioeconomic status (SES), and suggested that adversities during childhood and nutrition might be more important (Hope et al., 2013). It has therefore been suggested that the attractiveness of symmetry has more likely evolved to avoid highly asymmetric faces, which could signal a severe developmental disorder or genetic defect (Pound et al., 2014).

Sexual dimorphism is another cue to attractiveness that researchers have investigated for their association with health (Foo et al., 2017; Perrett et al., 1998; Rhodes, Chan, Zebrowitz, & Simmons, 2003). Sexual dimorphism in faces is expressed by masculine, testosterone driven, features in men, such as a stronger brow ridge, and more feminine, oestrogen supported, attributes in women, such as a suppression of facial hair (Little et al., 2011). However, studies reported mixed outcomes of facial sexual dimorphism in relation to health. This could be due to the inconsistent methods in measuring health (Coetzee et al., 2009), and the lack of a clear definition of 'health' in many studies.

The general appearance of facial skin, its colour and texture also play a role in attractiveness ratings. In particular, skin perfused with oxygenated blood is perceived as healthy (Stephen et al., 2011). Other aspects of skin colour such as carotenoid and melanin were examined in culturally and racially diverse populations (Stephen et al., 2011). The results of these studies suggest that carotenoids are also important in health perception across cultures, and are a valid cue to a healthy diet (Stephen et al., 2011).

Recently, facial adiposity has been identified as a cue to attractiveness and perceived health (Coetzee et al., 2009). Obese individuals are more prone to serious illnesses such as coronary heart disease, stroke and certain cancers, and underweight individuals more often have compromised immune function, lesser mental health and reduced fertility (Becka, Daly, Singh, & Taaffe, 2017; Warren et al., 2010). Therefore, facial adiposity has a good potential

as a valid cue to health (Coetzee et al., 2009). Indeed, the results of Coetzee et al.'s (2009) study show that facial adiposity is used as a cue to health and attractiveness. Raters could judge body weight from facial images alone, and they rated faces within the normal range of adiposity as more attractive and healthier than faces with very high or very low adiposity (Coetzee et al., 2009). Comparison with health data showed that overweight participants had higher blood pressure, which increases the risk for coronary heart disease, and other serious illnesses (Coetzee et al., 2009). This result supports the hypothesis that facial adiposity is a valid cue to health (Coetzee et al., 2009, 2011).

Some researchers have investigated facial cues to perceived psychological health, and found that raters judge people who are physically attractive as more psychologically healthy (Gupta, Etcoff, & Jaeger, 2015; Ward & Scott, 2018). Not only could physical attractiveness be a cue to psychological health, actual mental health could also influence physical attractiveness. For example, mental illness could have an impact on someone's appearance simply through the lack of sleep (Axelsson et al., 2010). The way children are treated by their peers, teachers and other influencers during adolescence is based on their attractiveness, more attractive children are thought to be more intelligent, prosocial and better friends (Langlois & Stephan, 1981), which could influence their mental health. A longitudinal study found that the level of facial attractiveness at the end of high school correlates positively with psychological well-being and negatively with depression (Gupta et al., 2015). The researchers also report that facial attractiveness has a similar effect on psychological well-being to family income or BMI (Gupta et al., 2015). Ward and Scott's (2018) study shows a strong correlation between facial attractiveness and perceived mental health, as well as a reflection of perceived mental health to actual mental health. Raters were able to accurately judge men's facial composite photos with regards to their mental health. This result could not

be completely explained by physical attractiveness, masculinity or physical health, but was identified as an additional influence on raters' judgements (Ward & Scott, 2018).

The presented studies give examples how recent research explored several facial cues to physiological and psychological health. Results relating to perceived health from these cues are strong; however, there are some mixed results regarding the relationship between face and body cues and underlying physical and psychological health.

1.3 Body cues to attractiveness and physiological and psychological health

Apart from judging attractiveness and health of potential mates from facial cues, people make judgements from bodies. This judgement could be one of the first cues that people perceive from strangers as body size and shape is more easily visible from a distance than facial features. Perceived body attractiveness can be influential in people's overall judgement of others (Alicke, Smith, & Klotz, 1986). A person with a high attractiveness body combined with a low attractiveness face is perceived as more attractive than a person with a low attractiveness body combined with a high attractiveness face (Alicke et al., 1986). People also made judgements of intelligence and sociability based on body attractiveness, whereas they based morality judgements on faces rather than bodies (Alicke et al., 1986). More recent research concentrated on the attractiveness of specific bodily cues, such as shape, size, waist-to-hip-ratio for females, waist-to-chest-ratio for males, and lumbar curvature in women.

Body size is often measured in BMI (Body Mass Index), fat percentages and body fat distribution, called gynoid and android fat (Faries & Bartholomew, 2012). Studies show that men and women in developed countries rate females with a healthy range BMI as appearing the most healthy, and toward the lower end of the healthy BMI range as most attractive (Brierley, Brooks, Mond, Stevenson, & Stephen, 2016; Faries & Bartholomew, 2012;

Stephen & Perera, 2014; Tovée, Furnham, & Swami, 2007). Men, however, are perceived as most attractive in Western cultures when they have greater lean muscle mass (Brierley et al., 2016). Preferences for female partners with a higher BMI have been found in African countries that experience food scarcity, and in rural regions of Malaysia (Swami & Tovee, 2005; Tovée et al., 2007). In the African societies, it might be advantageous for women to have a fuller figure as it signals absence of serious diseases, for example HIV. Weight loss is one of the first symptoms of HIV, the number one cause of death in younger adults in South Africa (Tovée et al., 2007). The results in Malaysia indicate that urban women might be more exposed to Western ideals of slimness, whereas in rural areas, fuller figures in women could reflect greater economic success (Swami & Tovee, 2005). It could also signal the ability to sustain a pregnancy and subsequent breast feeding despite food scarcity (Tovée et al., 2007). These results from different cultures could be due to cross-cultural or ecological differences, or a combination of these factors. For example, in Western cultures, societal influences driven by mass media, and most recently by social media such as Instagram and Facebook could affect how people view bodies (Brierley et al., 2016; Brown & Tiggemann, 2016; Fardouly, Diedrichs, Vartanian, & Halliwell, 2015; Fardouly, Pinkus, & Vartanian, 2017; Hargreaves & Tiggemann, 2009). However, in societies with a different ecological context, preferences can differ from affluent cultures.

Furthermore, waist-to-hip-ratio has been investigated as a cue to health and attractiveness (Singh, 1995). The author argues that women with a lower, 0.7 waist-to-hip-ratio or hour-glass figure, are perceived as more attractive, healthy and fertile than women with a more tubular body (Singh, 1995). According to Singh (1993, 1995), fertility and hormone level tests confirm that women with a lower waist-to-hip-ratio are more fertile than women with a higher waist-to-hip-ratio. However, Singh's (1995) methodology has been criticised, and some scholars claim that his findings could be potentially biased (Tovée et al.,

2007). Singh (1995) used line drawings as stimuli for observers, and when waist-to-hip-ratios are manipulated, the apparent BMI is also changed, thus making it impossible to differentiate between the two (Swami & Tovee, 2005). This methodical flaw is also apparent in other studies on waist-to-hip-ratio, that are either using manipulated line drawing as stimuli or digitally altered photographs, because a manipulation of the waist-to-hip-ratio also changes the BMI (Kościński, 2014). An attempted replication of Singh's studies yielded opposing results (Puhl & Boland, 2001). Some researchers claim that, even though, waist-to-hip-ratio is a factor in female attractiveness, body weight or BMI could be more important, but also subject to sociocultural influences (Puhl & Boland, 2001; Tovée et al., 2007).

More recently, researchers proposed women's lumbar curvature as another cue that is perceived as attractive in women, suggesting that men have evolved preferences for women with an ideal lumbar vertebral wedging, since this is associated with an increased ability to carry the weight of a pregnancy effectively (Lewis et al., 2015). However, this notion conflicts with findings in the medical literature. Although humans have adapted from quadrupedal to bipedal locomotion by reducing the length of the lumbar spine from seven to five lumbar vertebrae, and by evolving lumbar sexual dimorphism to allow for easier pregnancies (Whitcome, Shapiro, & Lieberman, 2007), the actual lordosis of the lumbar spine only develops as a child learns to walk (Preuschoft, Hayama, & Günther, 1988). In the early stages of walking, pressure and physiological stress of walking upright rather than crawling stimulate the growth plates of the vertebrae according to Pauwel's law (Preuschoft et al., 1988). In addition, the stability, and therefore curvature, of the spine is largely supported by muscles (Wagner, Liebetrau, Schinowski, Wulf, & De Lussanet, 2012).

Furthermore, the evidence of sexual dimorphism in the lumbar spine is mixed with some studies reporting none or only a very small difference between males and females

(Pavlova, Meakin, Cooper, Barr, & Aspden, 2014; Vialle et al., 2005). Some researchers find incidences of spinal sexual dimorphism in the developmental phase of puberty with growth spurts at different ages between males and females, which could explain the higher prevalence of idiopathic scoliosis in teenage girls (Longworth, Fary, & Hopper, 2014). Nevertheless, several factors influence spinal curvature, and only one of them is vertebral wedging; others include for example, pelvic tilt and sacral slope[1] (Vialle et al., 2005). Vertebral wedging is not considered the main contributor to lumbar lordosis (Legaye, Duval-Beaupere, Hecquet, & Marty, 1998). Additionally, it is not evident whether women who possess an ideal lumbar lordosis as proposed by Lewis et al. (2015), develop a reduced torque on the hip by vertebral wedging during pregnancy (Whitcome et al., 2007). Furthermore, studies reporting on the influence of high heels on attractiveness, suggest an alternative hypothesis that could be applied to the increased lumbar curvature cue as proposed by Lewis et al. (2015). This hypothesis posits that increased lumbar lordosis is a signal for an interest in mating, which women can manipulate by increasing their pelvic tilt or by wearing high heels (Guéguen, 2014; Lewis et al., 2017; Morris, White, Morrison, & Fisher, 2013). Future research is needed to explore these unresolved questions, and establish additional evidence to explain men's preference for a greater lumbar curve in women.

In summary, contrary to facial attractiveness, cues perceived from bodies may be subject to greater cultural influences driven by the media, or influences from ecological circumstances.

[1] The pelvic tilt is an angle measured between the midpoint of the sacrum and the centre-line between the two femoral heads, whereas the sacral slope refers to "the angle between the horizontal line and the cranial sacral end-plate tangent" (Vialle et al., 2005, p. 261).

1.4 Cues to attractiveness and health from gait and movement

Gait and movement is another field of evolutionary psychology research that seeks to identify cues to attractiveness and health. Similarly to perceptual cues from faces, people can make judgements quickly by observing gait and movement, using only a few cues. For example, observers are able to accurately discern sex and relative age by watching point-light walkers (Klüver, Hecht, & Troje, 2015; Montepare & Zebrowitz-Mcarthur, 1988). The point-light technique uses small glowing dots only on the main joints of walkers in black clothing, who walk in front of a black background. Thus, the movement pattern of the person is reduced to these light dots (Montepare & Zebrowitz-Mcarthur, 1988). People also make accurate judgements about BMI, symmetry and averageness from models in motion, presented either in point-light-technique or in computer-generated, realistic figures (Cazzato, Siega, & Urgesi, 2012; Doyle, 2009; Hoyet et al., 2013; Klüver et al., 2015), and some research has examined the question of whether gait could be a cue to fertility in women (Provost, Quinsey, & Troje, 2008). Studies show that women's gait changes depending on their menstrual cycle, and is perceived as more attractive during ovulation (Fink, Hugill, & Lange, 2012; Guéguen, 2012; Provost et al., 2008).

People have also been found to accurately detect emotional states, such as vulnerability, from gait (Book et al., 2015), suggesting that cues to underlying psychology may be found in the body.

1.5 Posture

Body posture as a cue to attractiveness and physiological and psychological health has not yet been thoroughly investigated in evolutionary psychology. The ideal, upright position of the human body for optimal functioning is characterised by minimal muscular

effort to maintain a perfect skeletal alignment with balanced weight distribution and good joint stability (Griegel-Morris, Larson, Mueller-Klaus, & Oatis, 1992). Measurements of good posture use landmarks such as the ear lobes, shoulders, hips, knees and ankles. This is often referred to as the plumbline measure (Griegel-Morris et al., 1992; Munivrana, Paušić, & Kondrič, 2011). In addition, good posture includes two normal lordotic (concave) curvatures in the cervical and lumbar spine, and two normal kyphotic (convex) curvatures in the thoracic and sacral portions of the spine (Griegel-Morris et al., 1992).

Modern sedentary life-style, and the increasing use of computers, laptops, and mobile phones have led to a decline of ideal posture, and given rise to health concerns (Alyami & Albarrati, 2016; Straker et al., 2008; Van Der Ploeg, Chey, Korda, Banks, & Bauman, 2012). These include lower back, neck and shoulder pain due to poor body posture, muscular imbalances, and conditions such as the upper crossed syndrome[2] of neck and shoulders (Janda, 1983). It is noteworthy that the postural problems and their associated health concerns mainly stem from sitting over a long period of time (Van Der Ploeg et al., 2012). Thus, incidental physical activity is important in the prevention of postural problems, and also concerning to other health related indicators, such cognitive function or heart rate (Sanchez-Lopez et al., 2018). In addition, poor posture negatively influences the optimal functioning of inner organs. Slouched posture, i.e. increased kyphosis, compresses inner organs and over time, it can lead to reduced lung capacity, heart, vascular, and digestive problems (Azizi, 2011). However, knowledge about the adverse effects of slumped posture is not new. In the

[2] The upper crossed syndrome refers to a typical muscular imbalance pattern, i.e. tightness of the upper back musculature, and a crossed over shortening of the chest muscles, combined with weakness in the deep cervical flexors and mid-back muscles.

early 20th century, parents expressed their concerns about their children slouching, and several textbooks were published to address these issues (e.g. Bancroft, 1913).

Today, sedentary lifestyle has increased compared to one hundred years ago, and recent research has linked poor posture and sedentary lifestyle to back pain, reduced overall health and higher mortality rates (Biswas et al., 2015; Lynch & Owen, 2015; Van Der Ploeg et al., 2012). An Australian study with more than 200,000 participants found that sitting for more than eight hours per day, including all sitting, such as sitting down for meals, sitting in the car or public transport, at work and at home, has a higher mortality rate than sitting for less than four hours per day (Van Der Ploeg et al., 2012). This finding highlights the dangers of the habit-forming behaviour of sitting, which is often a slumped posture. Once slumped posture becomes a habit, with rounded shoulders, increased thoracic kyphosis, and head forward position, actual physiological changes take place over time, skeletal muscles shorten and weaken, thus making it difficult for people to assume an upright posture (Ishikawa et al., 2017). These negative effects only become stronger with advancing age, and are paired with a reduced cognitive reaction time, slower muscle response latencies, loss of muscle mass, and increased spontaneous sway in a standing posture, which can all contribute to falls in older adults (Marsh & Geel, 2000).

Due to human bipedalism, standing is not the most critical moment in keeping balance, it is rather during the process of walking that humans must negotiate gravitational forces and balance on one leg (Janda, 1983). For the elderly, it is therefore important not to further compromise postural balance over and above the natural ageing process with bad postural habits and weakened postural musculature (Sinaki et al., 2002; Winter, 1995). Preserving the necessary strength and mobility for walking into old age, might not only be good to avoid falls, and maintain health, but also be a way of staying young in the perception

of others. A study investigating gait cues to sex, age and happiness, found that observers could accurately identify sex, and relative, but not absolute age of walkers, who were presented in point-light-technique (Montepare & Zebrowitz-Mcarthur, 1988). This is an interesting result, because it shows that people can perceive cues from minimal sources about posture and movement patterns relating to sex, relative age, and emotional status. Two studies investigating attractiveness of male and female bodies included posture as a cue to attractiveness (Gitter, Lomranz, & Saxe, 1982; Gitter, Lomranz, Saxe, & Bar-Tal, 1983). The study investigating male attractiveness found that male and female raters alike judged a protruding abdomen as least attractive (Gitter et al., 1982). Due to slouched posture, the abdomen of a person can protrude irrespective of body weight, however, this study also used line drawings as stimuli, a method that has been criticised as less reliable (Tovée et al., 2007). The study investigating female attractiveness found that targets with their shoulders back were rated as more attractive than targets with their shoulders forward, i.e. slumped posture (Gitter et al., 1983). However, this study also used line drawings, which may have rendered the results less reliable (Tovée et al., 2007). Both studies do not investigate any relationship between attractiveness and health, but rather suggest that people who wish to better their physical appearance should diet and exercise (Gitter et al., 1982, 1983).

1.6 Posture and mental state

The theory of embodied emotion posits a reciprocal relationship between the body and mental states (Niedenthal, 2007). This is consistent with evidence that brain activity changes between upright and slouched posture (Wilkes, Kydd, Sagar, & Broadbent, 2017). In an upright posture, more brainwaves in the beta and gamma frequencies are observed compared to slouched posture (Wilkes et al., 2017). In addition, the observed brainwaves have a larger magnitude in an upright posture and when recalling happy events (Tsai, Peper,

& Lin, 2016). Moreover, research has shown that it is more difficult to recall positive events in a slumped posture, and thus, slumped posture might hinder positive thinking (Tsai et al., 2016; Wilkes et al., 2017; Wilson & Peper, 2004). Similarly, research points towards a relationship between posture and self-evaluation (Brinol et al., 2009; Kozak, Roberts, & Patterson, 2014). Participants were asked to write down their best and worst characteristics for career success while either sitting in an upright or slouched posture, and the results demonstrate a significant impact of posture on participants' 'thought confidence', a meta-cognitive process of the awareness of one's own and other's thoughts (Brinol et al., 2009). Consistent with this research, a recent study found that maintaining an upright posture can buffer stress responses and protect self-esteem in a challenging situation (Nair et al., 2015). Stress can lead to depression in vulnerable individuals, especially those with low self-esteem, and the protective influence of upright posture is an important finding for psychology (Nair et al., 2015).

These studies show that posture can influence mental state. However, mental state can also influence posture. Indeed, the effect of mental health on posture has been recognized in the Diagnostic and Statistical Manual of Mental Disorders (5th ed., DSM-5, American Psychiatric Association, 2013) regarding major depressive disorder, which uses seated slumped posture as a diagnostic criterion for depression. This notion is supported by studies suggesting a relationship between increased slumped posture and severity of depression (Wilkes et al., 2017). In a study exploring the question of whether sadness can alter posture, results show an association between protrusion of the shoulders and sadness (Do Rosário, Diógenes, Mattei, & Leite, 2013). Furthermore, other research has found that depressed individuals experience slumped body posture, which can become chronic, and is similar to slumped posture due to modern sedentary lifestyle (Do Rosário et al., 2013).

Based on previous research, the theory of embodied emotion, and the premise that expansive posture signals dominance, there has been keen interest in power posing. A study examining the effect of power posing on hormones and economic risk taking was published, claiming that participants had higher hormone levels, and were more open to risk taking after holding a power pose for one minute (Carney, Cuddy, & Yap, 2010). This paper has since been heavily criticised as a false positive by the research community, and its results have not been replicated (Smith & Apicella, 2017). Whilst Carney et al.'s (2010) study on power poses is controversial, other research into embodiment of emotions is still widely accepted. Further research is needed, which should incorporate recently developed precautions such as the use of modern statistical methods in response to the replication crisis in psychology (Erceg-Hurn & Mirosevich, 2008; Smith & Apicella, 2017).

1.7 Cues to mental state

In the pursuit of a high-quality mate, attractive people are not only chosen for their good looks, but also for their personality traits and interpersonal characteristics. In their classic study, Dion, Berscheid and Walster (1972) suggest that the stereotype 'beauty equals goodness' exists. The authors show that physically attractive people are perceived as having more socially desirable personality traits, as well as being perceived as leading more successful and happier lives than less attractive people. Subsequent research has confirmed this finding, and has since expanded this premise by demonstrating that attractive children and adults are perceived as better adjusted, socially more appealing, academically and interpersonally more competent, and are treated better than unattractive children and adults (Langlois et al., 2000; Zebrowitz & Montepare, 1992). The phenomenon of people attributing more positive inner qualities to good looking individuals has also been called 'the halo effect' (Zebrowitz & Montepare, 1992). In contrast, other researchers proposed the reversal of the

beauty stereotype, claiming that ‘What is good, is beautiful’ (Little, Burt, & Perrett, 2006). In their study, the authors concluded that the desired personality traits might be the reason for people’s quest to find faces that reflect these traits (Little et al., 2006). Nevertheless, people are able to make quick judgements about others, including intelligence, trustworthiness, and sociosexuality, even from composite faces (Boothroyd, Jones, Burt, DeBruine, & Perrett, 2008; Krupp, DeBruine, & Jones, 2011; Zebrowitz & Rhodes, 2004).

1.8 Self-esteem

Self-esteem may be reflected in people’s body posture, in a similar manner to the posture of depressed individuals, and it is therefore important to examine a possible connection (Wilkes et al., 2017). The role of self-esteem in mental health has been investigated extensively by psychological research, identifying low self-esteem as a risk factor for depression, suicide and victimisation by others (Emler, 2002). Furthermore, self-esteem is an important construct in psychology with a long history and many papers written on the topic (Rhodewalt & Tragakis, 2003). It is therefore unsurprising that it is difficult to provide a simple definition for self-esteem, and classifications range from self-esteem as a unidimensional construct, contingent versus true self-esteem, defensive versus non-defensive self-esteem, explicit versus non-explicit self-esteem, fragile and authentic self-esteem to a process model of self-esteem (Mruk, 2013; Rhodewalt & Tragakis, 2003). It has been suggested to view self-esteem as a two-factor construct of competence and worthiness (Mruk, 2013). Another view postulates self-esteem as part of the self-regularity process that constantly seeks to maintain or enhance one’s self-concept by using behavioural and cognitive strategies (Rhodewalt & Tragakis, 2003). The latter definition provides a better understanding of the possible link between self-esteem, posture and attractiveness, because

one behavioural strategy for maintaining or enhancing one's self-concept could be adjustments in one's body posture.

Evidence from longitudinal research demonstrates that low self-esteem is a contributing risk factor for suicide, depression, teenage pregnancies, and victimisation (Chatard, Selimbegovic, & N'dri Konan, 2009; Trzesniewski et al., 2006). Some research, mainly in the medical field, indicates a relationship between low self-esteem and health (Stinson et al., 2008). For example, individuals with low self-esteem have higher levels of cortisol, a stress hormone, which if chronically elevated, can lead to negative health outcomes (Stinson et al., 2008). With regards to perception of self-esteem in others, some research has provided evidence that people can easily discern emotions by observing others either seated or standing, and make inferences about self-esteem (Franzoi & Herzog, 1986; Pitterman & Nowicki, 2004; Zeigler-Hill, Besser, Myers, Southard, & Malkin, 2013).

Moreover, raters find people with high self-esteem attractive, and would prefer them as potential partners over those with low self-esteem or very high self-esteem (Zeigler-Hill & Besser, 2014). The authors posit a similar implicit theory about self-esteem as about physical attractiveness, the 'beauty equals good' stereotype that was suggested by Dion, Berscheid, and Walster (1972). People with high self-esteem are thought to also possess other positive qualities that make them desirable as a mate (Zeigler-Hill & Besser, 2014). There are some differences in the perception of men and women. Men tend to be more desirable when they have high self-esteem, whereas women are sometimes judged negatively when perceived as high in self-esteem (Zeigler-Hill & Besser, 2014). This could be explained with societal influences that prefer women to be 'nice', which might be reflected in a lower self-esteem, whereas high self-esteem may be associated with narcissism, assertiveness and leadership (Zeigler-Hill & Besser, 2014).

Similar to preferences for facial averageness, people may prefer others in a mid-range of self-esteem. Research shows that average faces are preferred over faces that fall outside the norm (Park, van Leeuwen, & Stephen, 2012). Self-esteem ratings falling outside the norm might not be perceived as desirable. Although women generally prefer men with a higher self-esteem, extreme displays of self-esteem are not favoured, but rather interpreted as narcissistic (Zeigler-Hill & Besser, 2014). Moreover, men mostly do not prefer women with an extremely high self-esteem, especially when they consider their own self-worth. For example, men with low self-esteem tend not to feel good about themselves when partnered with a woman with high self-esteem (Zeigler-Hill & Besser, 2014).

Although, there is a large body of research available concerning self-esteem, only very little research on self-esteem and body posture has been conducted. One study, conducted in Iran, measured whether self-esteem would correlate with a forward-head position and rounded shoulders, indicators of slumped posture (Korooshfard, Ramezanzade, & Arabnarmi, 2011). The results show a significant correlation between self-esteem and rounded shoulders, but no correlation between self-esteem and forward-head position (Korooshfard et al., 2011). Although, these findings are interesting, the study suffers from limitations. For example, methods and statistical information lack detail, and will make it problematic to replicate this study. Furthermore, many sentences in the article, although written in English, are difficult to understand, and some of the content might have been lost in translation.

Another study examined the association between wearing make-up, posture and self-enhancement (Osborn, 1996). Self-enhancement strategies are thought to belong to the construct of self-esteem as discussed above (Rhodewalt & Tragakis, 2003). Osborn (1996) proposed that wearing make-up, and presenting in an upright posture would be part of

women's self-presentation and self-enhancing strategies, and rated favourably by observers. Stimuli were images of women, who either wore make-up or not, and were positioned in three different postures: slouched, normal, and military stance (Osborn, 1996). In the posture condition, faces were disguised to avoid a confounding effect (Osborn, 1996). Raters were also asked to judge the images on personality, health, fertility, and sociosexuality. The different postures had a significant effect on the ratings, and overall, slumped posture was rated as less attractive than standard or military posture (Osborn, 1996). With regards to personal characteristics, participants judged targets with slumped posture as "duller, less sociable, more submissive, more modest, having more medical problems, being less fertile, less likely to have an extramarital affair, and less attractive" (Osborn, 1996, p. 42). These results are promising regarding body posture as a cue to attractiveness and self-esteem. However, due to the limitations mainly concerning the stimuli of Osborn's study (1996), as only women's images were used in the overall study, and only two models in the posture condition, more reliable evidence examining these research questions is needed.

1.9 Research Aims and Hypotheses

This research intended to contribute to the open questions as outlined above, exploring the role of body posture in the perception of attractiveness and self-esteem. The research question was whether body posture is a valid cue to self-esteem. After an initial phase of stimulus collection, two separate studies were conducted to explore the planned hypotheses. Study 1 investigated correlations of self-reported self-esteem, body posture, and perceived self-esteem and attractiveness. In addition, a mediation analysis ascertained whether posture mediated the relationship between attractiveness and self-esteem. Study 2 explored the influence of posture on perceived self-esteem and attractiveness via a forced-choice task.

The following three hypotheses were proposed:

1. Upright posture will be perceived as more attractive
2. Upright posture will be perceived as higher self-esteem
3. Posture will mediate a relationship between self-reported self-esteem and perceived attractiveness (and perceived self-esteem), suggesting that posture is a valid cue to self-esteem.

2. Methods

This research was approved the Macquarie University Human Research Ethics Committee (MQ HREC), and all participants gave prior, informed consent in writing (see Appendices A and B). Participants were aware that they could withdraw from the research at any stage without consequences.

2.1 Stimulus production phase

This phase served to collect stimuli for the two planned studies.

2.1.1 Participants. Initially, 116 Caucasian participants (48 male) were recruited from the undergraduate participant pool (SONA) or as friends, family and acquaintances of the researcher. Participants from the SONA pool were given 2 credit points for participating in this study, whereas participants recruited outside of the SONA pool were reimbursed $20 for their time. However, six participants had to be removed from the sample due to ethnicity (non-Caucasian) or age (>40) restrictions, and two further participants declined to be photographed. One hundred and eight participants (47 male) remained in the final sample (M_{age} = 20.96 years, SD = 3.65).

2.1.1.1 Power. A power analysis was performed by using G*Power (version 3.1.9.2; Faul, Erdfelder, Buchner, & Lang, 2009) for bivariate correlations and MedPower for mediations effects (Kenny, 2017), which showed that our sample gave 80% power to detect small to medium effect sizes for all analyses.

2.1.2 Measures.

Participants were asked to first complete an online-questionnaire, administered via Qualtrics, which is a software program specialising in surveys (www.qualtrics.com; Qualtrics Labs Inc., Provo, UT). The questionnaire comprised of a set of self-report statements relating to participants' self-esteem using three scales from the International Personality Item Pool (IPIP, 1992/2017), which provides validated versions using standardised anchors and scale points, avoiding the need for participants to switch between scale formats during the questionnaire phase of the study: The Physical Attractiveness (Rational Scale; IPIP, 1992/2017; Goldberg et al., 2006), the Self-esteem scale (IPIP, 1992/2017; Rosenberg, 1965), and the Self-Consciousness (IPIP, 1992/2017; Buss, 1980) scale, In addition, the State Self-Esteem Scale (Heatherton & Polivy, 1991) was administered. See Appendix C for items of all scales.

2.1.2.1 Physical Attractiveness (Rational Scale). This scale from the International Personality Item Pool (IPIP-Rational Scale; Goldberg et al., 2006) consists of nine items (three negatively scored) asking about participants' own perception of their physical attractiveness. This scale was found to be highly reliable ($\alpha = .87$; IPIP, 1992/2017). Answers to questions such as 'I like to look at myself in the mirror' are recorded on a 5-point Likert scale (1 = not at all, 2 = a little bit, 3 = somewhat 4 = very much, 5 = extremely true), and then summed. Higher scores indicate higher levels of perceived physical attractiveness. This scale was chosen to capture the physical attractiveness aspect of self-esteem.

2.1.2.2 Self-Consciousness scale (Buss, 1980). This measure evaluates self-consciousness both on a private and on a public level, and is divided into two subscales (Buss, 1980). The private self-consciousness sub-scale (α = .81) is comprised of ten items, four are negatively scored. Responses to questions like 'I examine my motives constantly' are scored on a 5-point Likert scale (1 = not at all, 2 = a little bit, 3 = somewhat 4 = very much, 5 = extremely true), and summed with higher scores showing higher levels of private self-consciousness. The public self-consciousness sub-scale (α = .77) has 12 items and six are negatively scored on the 5-point Likert scale as above. An example question is: 'I worry about what people think of me'. This measure with its two subscales was utilised to distinguish between self-awareness of an inner state and self-consciousness in public, which both contribute to self-esteem.

2.1.2.3 Self-Esteem Scale (Rosenberg, 1965). Rosenberg's scale (1965) is widely used in the literature to measure self-esteem, and shows high reliability with a Cronbach's alpha of .84. It has ten items with five being reversed scored on a 5-point Likert scale (1 = not at all, 2 = a little bit, 3 = somewhat 4 = very much, 5 = extremely true). An example item is 'I know my strength'. This scale was chosen because of its acceptance in the literature as a valid measure of self-esteem (Robins, Hendin, & Trzesniewski, 2001).

2.1.2.4 State Self-Esteem Scale (SSES; Heatherton & Polivy, 1991). This scale has an overall score, and three subscales, performance self-esteem, social self-esteem, and appearance self-esteem. The SSES scale has 20 items (α =.92), 13 are reverse scored, and was chosen to include a measure of self-esteem that is robust in measuring a person's more stable state rather than their more temporary mood (Heatherton & Polivy, 1991). Example questions such as, 'I feel that others respect and admire me' and 'I feel like I'm not doing

well,' are scored on a 5-point Likert scale (1 = not at all, 2 = a little bit, 3 = somewhat 4 = very much, 5 = extremely true).

2.1.2.5 Other personal data. Participants answered some demographic questions, including age, gender, and ethnicity. In addition, participants' height, weight, and body mass index (BMI) was collected (see Appendix E). Participants also completed a number of health and personality questionnaires for unrelated studies.

2.1.3 Procedure

Participants took part in the stimulus production phase individually, and only the experimenter was present during the study. Participants were asked to meet outside the laboratory, where the experimenter greeted them. After a participant was taken to the room, the experimenter explained the procedure and asked the participant to read and sign the information and consent form (see Appendix B). Once agreed to proceed, each participant completed the online questionnaire comprising of demographic, health and self-esteem related questions, in about 15-25 minutes. Each participant used a Windows 10 DELL or ASUS desktop computer with a 23.8-inch screen to complete the survey and was seated approximately 60 centimetres away from the screen, in a room with blacked out windows. For the remainder of the stimulus collection phase, the experimenter asked the participants to change into the provided grey singlets and shorts while the experimenter left the room. Participants were asked to remove all jewellery, glasses, socks and shoes, tie long hair up for a visible neck line, and females were encouraged to not wear a bra under the singlet. The provided grey singlets and shorts matched the participants' own size as closely as possible (available sizes were XS to XL for females, and 70 to 105 centimetres waist for males). The aim was to achieve a tight fit so that body shape and posture were clearly visible, and to remove potential confounding effects of clothing style. Once participants had changed, the

experimenter recorded their height using a tape measure fixed to the wall to one decimal place in centimetres, and weight using a Tanita SC330 scale. The parameters for the Tanita scale were set to 0.2 for weight of the clothes and standard build for all participants. Sex, age, and height were individually entered, and the results printed and attached to each participant's physical file. These measurements were later used to calculate the BMI for each participant.

Following these measurements, photographs of the participants were taken in a 117 x 90 x 210 centimetres booth, painted with Munsell N5 Neutral Grey paint. 15 Verivide T12/D65 daylight simulating fluorescent tubes were used to illuminate the booth. High frequency fixtures reduced flicker, and Perspex diffusers were used to ensure even light distribution. The room had blacked out windows, the door was closed, and overhead lights switched off. No other sources of light were used during the photographic sessions. The camera, a Canon EOS 70D DSLR camera with an 18-55mm lens (focal length held constant for all images), was mounted on a tripod one metre above the floor and three metres away from the booth. The photographs of the participants were taken remotely by using the EOS Utility program installed on a second Windows 10 DELL computer in the same room. The camera settings were the same for all images at a 1/50sec exposure time, a lens aperture of F/5.6, white balance set at 6500K and an ISO speed rating of 200.

For this part of the stimulus collection phase, the experimenter explained to the participants where to stand in the box for the photographs and told participants that at first some test photographs would be taken to ensure the lighting was correct. However, this part was deliberately used to achieve a natural and relaxed posture of the participants where they would not think about posing for the camera. The first photograph was then used to determine whether the participant had an upright or slouched posture by comparing the image against the plumbline measure (see Figure 1 for an illustration), which is commonly used to

assess correct posture among physiotherapists, chiropractors and massage therapists, both ad hoc during physical postural assessments and on photographs (for example, Munivrana, Paušić, & Kondrič, 2011).

Figure 1: Plumbline measure for correct posture, black line is the correct posture (plumbline), the white line shows the diversion from the ideal line (Munivrana, Paušić, & Kondrič, 2011)

Posture as measured via the plumbline measure (Munivrana et al., 2011) yielded 13% of participants with a naturally upright posture, and 87% naturally slouched posture. It is important to note that the experimenter, a qualified muscular-skeletal therapist performed this assessment on each participant visually during the process of taking photographs[3]. If according to this visual assessment, participants' natural posture was correct, they were instructed to slouch a little before the next set of photographs were taken. However, if the participant's natural posture was slouched, the next set of photographs were taken after giving corrective posture instructions as follows:

[3] This skill can be acquired with training, but for this study, the required skill was already part of the experimenter's skillset.

1. Place your feet parallel to each other.
2. Lift up from under the rib cage (point fingers at your own ribs and show how to get from a slouched position to a 'lifted' position).
3. Gently engage your core without tensing up.
4. Relax your shoulders down and move your head back but keep your chin parallel to the floor.

If participants were not able to follow these verbal instructions, the experimenter either demonstrated the posture, or checked whether participants were comfortable being corrected using hands-on assistance. None of the participants objected. The hands-on corrections were mostly necessary for head position and head tilt.

After the photographic session, the participants were asked to change back into their own clothes while the experimenter left the room, and were finally thanked and dismissed. Their photographs were then analysed to determine the deviation from the correct posture in both their natural posture and the corrected posture photograph using a set of angles (see section 2.2.2 and Figure 2).

2.2 Study 1

2.2.1 Cases

Of the 116 cases that were originally recruited during the stimulus collection phase, six cases were omitted for study 1 due to ethnicity or age restrictions (aged 40 or over). Two cases were excluded due to missing data / photographs. The remaining 108 cases were Caucasian participants (47 male), and aged between 18 and 36 (M_{age} = 20.96 years, SD = 3.65). BMI ranged from 17.5 (underweight) to 32 (obese) (M_{BMI} = 23.06, SD = 3.15).

2.2.2 Posture

In addition to the plumbline assessment described in section 2.1.3, which resulted in 15 (13%) naturally upright postures and 93 naturally slouched postures, each photograph was processed manually. Angles of the cervical spine, head tilt, and shoulders were measured for each case to obtain continuous measures of posture (see Figure 2 for an illustration; Raine & Twomey, 1994). For example, angle 1 is the angle of the cervical spine. This angle is greater in a more upright posture, and smaller in a more slouched posture.

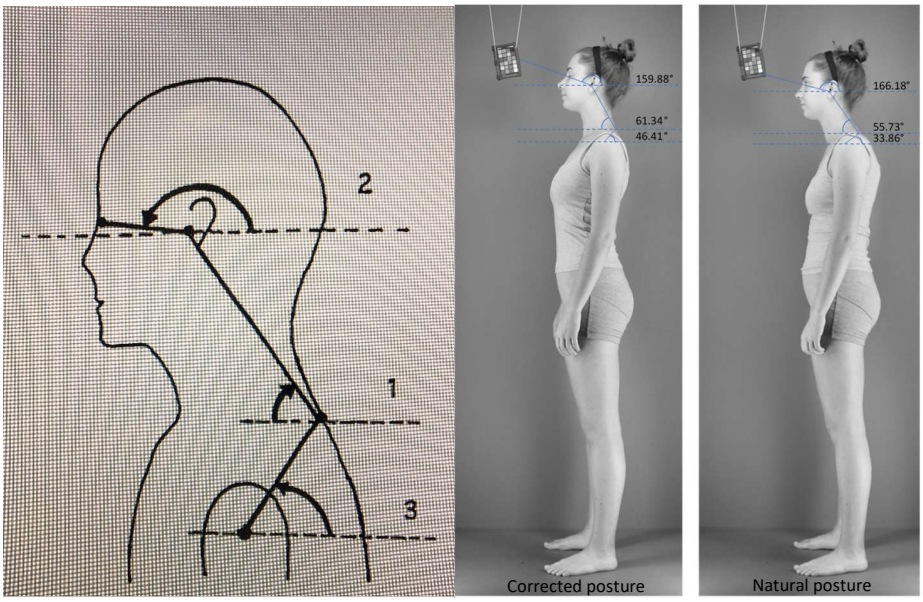


Figure 2: Illustration of the three angles used (Cervical spine, head tilt, shoulder; adapted from Raine & Twomey, 1994)

Higher numbers for all angles indicate a more upright posture. The angles for cervical spine or neck (M_{neck} = 55.58, SD = 4.78) ranged between 43.30 degrees (extremely slouched) to 65.26 (extremely upright). Measured angles for the head tilt (M_{head} = 166.34, SD = 6.07) ranged from 145.91 (extreme head forward position, looking down) to 182.17 (extreme head tilt upwards, looking up). Shoulder angles ($M_{shoulder}$ = 41.15, SD = 13.42) ranged from 17.32 degrees (shoulders extremely rounded) to 83.33 (extremely upright).

2.2.3 Raters

Thirty-Eight Caucasian raters (12 male) were recruited through the undergraduate pool SONA as described above for the stimulus production phase. They were Macquarie University undergraduates between the ages of 18-40 (M_{age} = 21.13, SD = 4.57), and received 1 credit point or $10 for their participation. All raters were naïve to the hypotheses.

2.2.4 Materials

Stimuli were presented via Qualtrics, and raters were asked to rate the attractiveness and self-esteem of each person from their body photograph (photographs obtained in the stimulus production phase) showing their natural posture. This was presented in four blocks, female attractiveness, male attractiveness, female self-esteem, and male self-esteem (e.g. Figure 3). The sequence of stimuli as well as the four blocks were randomly presented. Raters evaluated the attractiveness of the bodies on a 7-point Likert scale, from very unattractive to very attractive, and the self-esteem of the bodies on a 7-point Likert scale from very low self-esteem to very high self-esteem. Stimuli were presented in the left sagittal plane, and the faces in the images were blurred using the Photoshop ‘pixelate’ function to reduce the influence of faces on ratings, and the background rendered a uniform grey using Adobe Photoshop (Figure 3). Raters were seated approximately 60 centimetres from a 23.8-inch screen on a Windows 10 ASUS or DELL desktop computer. Up to five raters at a time completed the study in a room with five computers set up in cubicles to reduce any distractions from other raters. The researcher was seated without direct vision of any of the raters’ screens.

Figure 3: Stimulus in left sagittal plane (study 1)

2.2.4.1 Statistical methods. Bootstrapped Pearson's correlations were conducted to evaluate whether raters' perception of attractiveness and self-esteem correlated with the participants' own perception, which was assessed through the four self-report measures as described in section 2.1.2. In addition, a mediation analysis was performed to establish whether posture mediated self-esteem in rated attractiveness.

2.2.5 Results

The statistical program IBM SPSS Statistics version 24 was used to analyse the data. The PROCESS v3.1 plugin (Hayes, 2018) was used to perform the mediation analysis.

Table 1 Descriptive Statistics for continuous variables

Continuous Variable	Rosenberg Self-esteem Scale	Physical Attractiveness Scale	Private Self-consciousness Scale	Public Self-consciousness Scale	Rated Self-esteem
N	108	108	108	108	108
Mean	35.38	28.95	35.43	40.96	4.15
Standard Deviation	6.78	6.38	5.19	8.37	0.76

	State Self-esteem Scale (SSES)	SSES Sub-scale 'Performance'	SSES Sub-scale 'Social'	SSES Sub-scale 'Appearance'	Rated Attractiveness
N	108	108	108	108	108
Mean	69.46	25.94	23.81	19.72	3.81
Standard Deviation	13.52	5.18	6.08	4.63	0.91

2.2.5.1 Descriptive Statistics. Descriptive statistics were performed to obtain means and standard deviations for the variables[4] (see Table 1 Descriptive statistics for variables). Shapiro-Wilk tests of normality found that most continuous variables were not normally distributed. Therefore, bootstrapped Pearson's correlations were conducted for the statistical

[4] Descriptive statistics for age, measured angles and BMI were reported under 2.2 Study 1

analyses. Bootstrapping is considered acceptable to address normality issues in the distribution of moderate (N ≈ 65) to large sample sizes (Sideridis & Simos, 2010).

2.2.5.2 Correlations. Bootstrapped Pearson's correlations between the self-esteem measures, the postural measurements and the rated attractiveness and rated self-esteem outcomes were completed (see Table 2). Bootstrap results are based on 1000 bootstrap samples.

In addition, BMI was measured and correlated with rated attractiveness and rated self-esteem as well as the self-esteem measures. The correlation between rated attractiveness and BMI was significant (p = .009) (see Table 2b), and the correlation between BMI and the SSES subscale 'Performance' was significant (p = .006). All other correlations between BMI and the other self-esteem measures as well as rated self-esteem were not significant (see Appendix E for all other correlations with BMI).

The largest correlations, whether males and females separately or combined, were between rated attractiveness and rated self-esteem, females r_{boot} = .908, males r_{boot} = .955, combined r_{boot} = .917. In addition to the correlations presented in the table, the following correlations were noted: the correlations between self-reported private self-consciousness (Buss, 1980) and all other self-esteem measures were not significant, whereas the public self-consciousness scale (Buss, 1980) correlated with all other self-esteem measures. Both scales had no significant correlations with rated attractiveness and rated self-esteem, see Appendix D.

Table 2

a) Results of bootstrapped Pearson's correlations for all scales

Scale	Rated Attractiveness	Rated Self-Esteem
Physical Attractiveness	.220* [.020, .402]	.230* [.039, .405]
Private Self-Consciousness	-.101 [-.301, .102]	-.048 [-.269, .173]
Public Self-Consciousness	-.081 [-.272, .114]	-.164 [-.355, .038]
Rosenberg Self-Esteem	.216* [.007, .414]	.281** [.084, .462]
State Self-Esteem (overall)	.067 [.262, .162]	.162 [-.035, .343]
State Self-Esteem (social)	.010 [-.184, .198	.104 [-.089, .288]
State Self-Esteem (appearance)	.242* [.062, .405]	.277** [.118, .421]
State Self-Esteem (performance)	-.51 [-.253, .164]	-.52 [-.161, .252]

* p < .05; ** p < .01 *** p < .001.

All confidence intervals are bias corrected, accelerated, bootstrapped 95% confidence intervals (1000 samples).

b) Results of bootstrapped Pearson's correlations for angles (head, neck and shoulders) and BMI

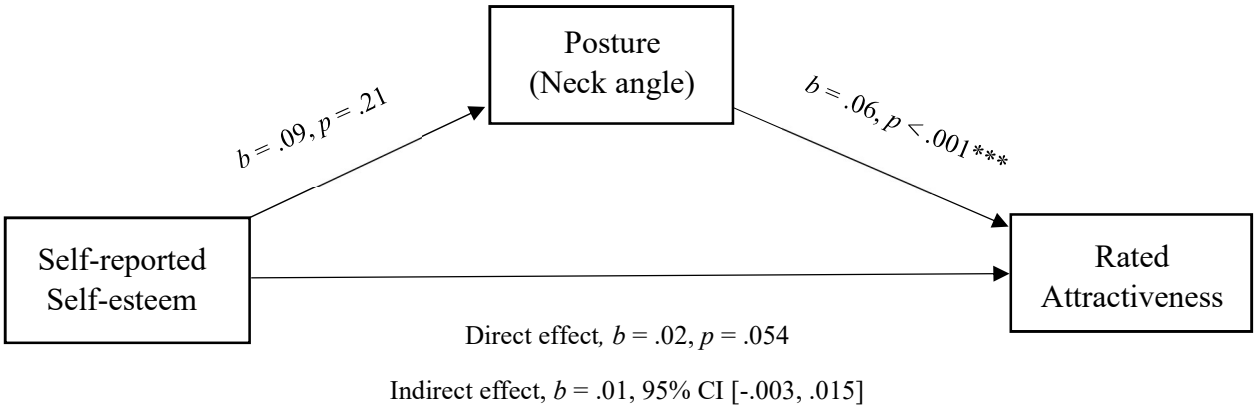
Measure	Head	Neck	Shoulders	BMI
Rated Attractiveness	.033	.339***	-.026	-.264**
	[-.143, .210]	[.142, .509]	[-.248, .197]	[-.464, -.030]
Rated Self-Esteem	-.102	.482***	-.006	-.150
	[-.278, .097]	[.308, .622]	[-.201, .211]	[-.352, .075]

* p < .05; ** p < .01 *** p < .001.

All confidence intervals are bias corrected, accelerated, bootstrapped 95% confidence intervals (1000 samples).

2.2.5.3 Mediation Analysis. Following these correlational results, a mediation analysis was performed. Between the two self-reported self-esteem scales with significant results in the correlation (State Self-Esteem appearance subscale and the Rosenberg scale), the Rosenberg self-esteem scale (Rosenberg, 1965) had the stronger relationship. Of the posture measures, only the neck angle measurement was significantly related to perceived attractiveness and perceived self-esteem, and therefore, neck angle, as a measurement of posture, and the Rosenberg scale (1965) were used for the mediation procedure. Figure 4 shows the mediation model relationship between rated attractiveness, self-reported self-esteem (Rosenberg scale), and posture (neck angle). The mediation procedure was conducted to establish whether posture (neck angle) mediated the relationship between self-reported self-esteem and rated attractiveness. This was computed by using bootstrapping procedures with the Hayes PROCESS add-on (Hayes, 2018). As illustrated in Figure 4, the indirect effect

of posture on rated attractiveness through self-reported self-esteem was not statistically significant, b = .01, 95% CI [-.003, .015], suggesting that posture does not mediate the relationship between self-reported self-esteem and rated attractiveness. The direct effect of posture on rated attractiveness was significant, b = .06, p < .001, and the direct effect of self-reported self-esteem on rated attractiveness was just outside the significance level of .05 (see Figure 4). Furthermore, including BMI as a covariate to control for the relationship between BMI and perceived attractiveness did not change the pattern of results (Appendix G).



* p < .05; ** p < .01 *** p < .001.

Figure 4

Regression coefficients for the relationship between 'Rated attractiveness' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant.

The analysis was repeated separately for male and female bodies, and the pattern of results was similar (see Appendix G). Furthermore, the analysis was repeated using the SSES appearance subscale, which was also significantly correlated with rated self-esteem, and the

pattern of results was the same (see Appendix G). In addition, the analysis was repeated using perceived self-esteem instead of perceived attractiveness and the pattern of results was the same (Appendix G).

2.2.6 Discussion

It was postulated in hypothesis 1 that upright posture was perceived as more attractive. It was also proposed in hypothesis 2 that it was perceived as higher in self-esteem. There was a significant positive relationship between posture and both perceived attractiveness and perceived self-esteem, such that raters perceived naturally more upright posture as more attractive and higher in self-esteem than a naturally more slouched posture. Even though raters perceive a more upright posture as more attractive and higher in self-esteem, the lack of a significant relationship between self-rated self-esteem and posture suggests that people with higher self-esteem do not necessarily hold themselves in a more upright posture. Hypothesis 3 posited that posture mediated a relationship between self-reported self-esteem and perceived attractiveness. This hypothesis was not supported, suggesting that posture may not represent a valid cue to health. These findings and their implications will be discussed further in the general discussion.

2.3 Study 2

Study 1 explored the relationship between naturally upright posture and perceived attractiveness and self-esteem. However, this was a correlational design and thus cannot determine causation. Study 2 will use an experimental design to examine whether upright posture causes increases in perceived attractiveness and self-esteem.

2.3.1 Raters

For study 2, 42 Caucasian raters (12 male) were recruited through SONA as described above for study 1. They were Macquarie University undergraduates between the ages of 18-43 (M = 21.64, SD = 5.24), and received 1 credit point or $10 for their participation. As in study 1, all raters were naïve to the hypotheses.

2.3.2 Measures

Participants were presented with a series of pairs of bodies. Each pair was the upright posture of a person in the left sagittal plane and the slouched posture of the same person side by side (see Figure 5 and Figure 6 for an illustration). The stimuli were presented randomly in four blocks (male attractiveness, female attractiveness, male self-esteem, female self-esteem), and in each block the position of the upright/slouched photograph was also randomized either left or right. Participants completed a forced-choice relative judgement questionnaire regarding each person's attractiveness and self-esteem. The blocks were introduced with the instruction: 'For this next block, please rate the ATTRACTIVENESS of each body.' or 'For this next block, please rate the SELF-ESTEEM of each body. For each pair of bodies observers answered the questions 'Which one is more attractive?' or 'Which one has more self-esteem?' respectively. Answers were given via a slider from 0 labelled as 'Definitely this one' to 100 'Definitely this one' to decide which stimulus was more attractive / had more self-esteem. For all questions, both male and female observers scored male and female stimuli.

Mean scores for each body identity was calculated. Scores below 50 indicated that observers perceived the slouched body as more attractive or higher in self-esteem, '50' specified no preference, and scores above 50 indicated that observers perceived the upright

body as more attractive or higher in self-esteem. One sample t-tests were conducted, and Cohen's d effect sizes were calculated to compare raters' perception of attractiveness and self-esteem of upright posture against slouched posture.

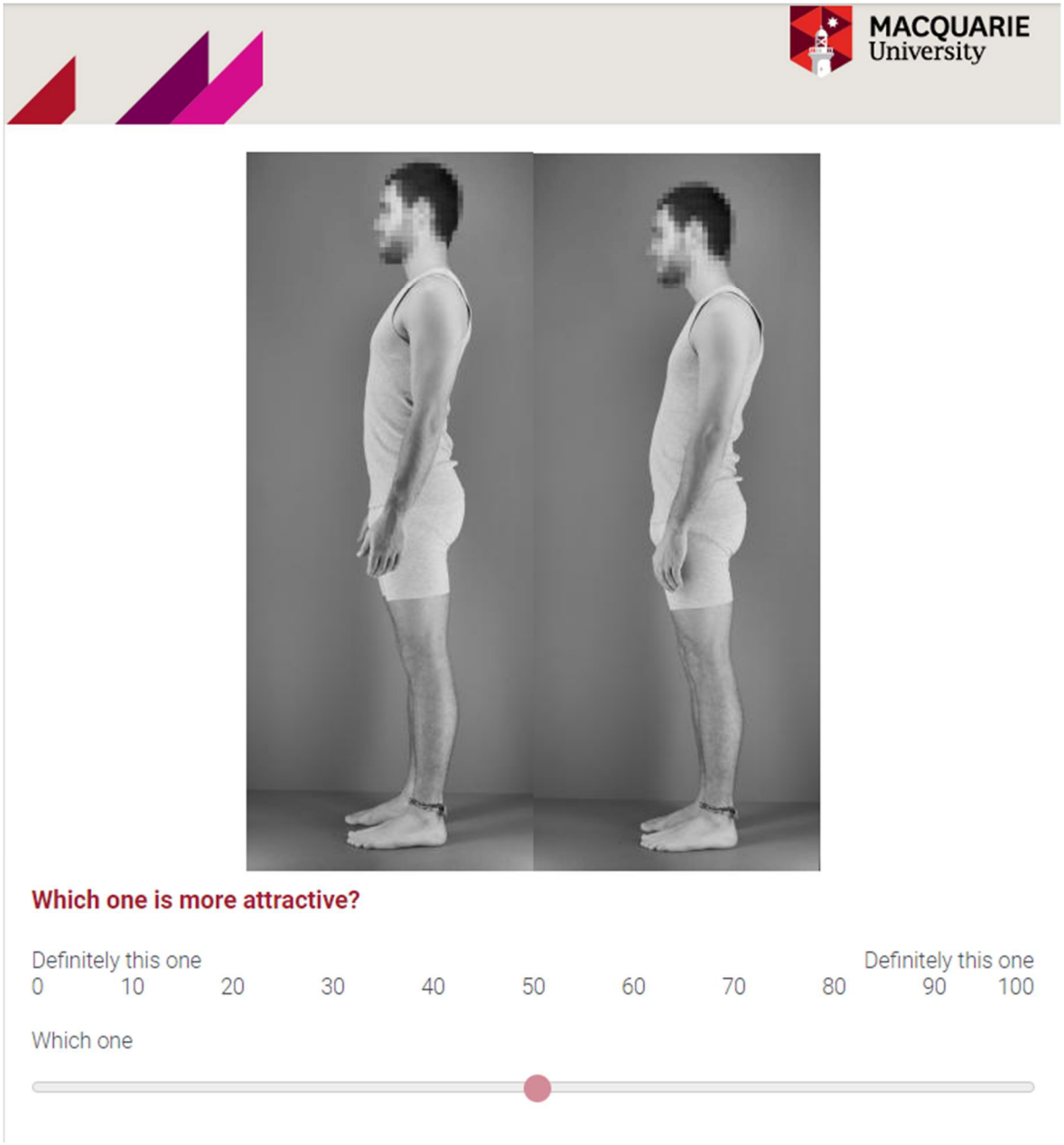


Figure 5 Sample illustration of stimuli for study 2. Left photograph is upright, right photograph is slouched.

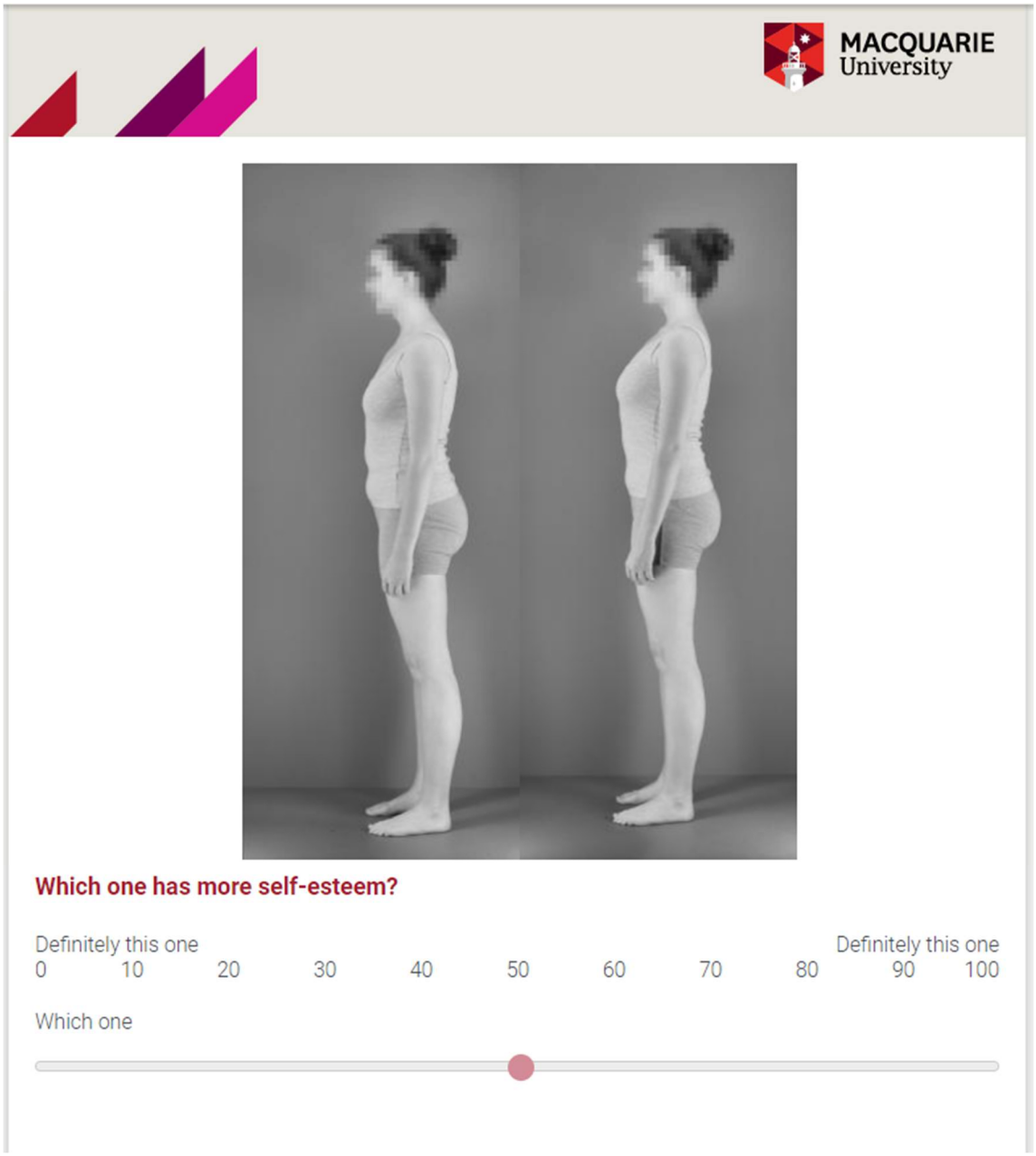


Figure 6 Sample illustration of stimuli for study 2. Left photograph is slouched, right photograph is upright.

2.3.3 Results

The statistical analysis for study 2 was conducted using IBM SPSS Statistics, version 24. Two outliers were identified during the analysis. Possibly this was because they had either no visible difference between natural and corrected posture or an unnatural appearance

in the corrected posture. However, it was decided to keep them in the sample, because including or excluding them did not change the pattern of results.

One sample t-tests were conducted against a comparison value of 50 ('no preference'), and results are shown in Table 3. Participants chose the upright posture as more attractive and as higher in self-esteem significantly more than by chance. Cohen's d effect sizes were calculated, and all effect sizes were very large. The statistical analysis was repeated for males and females separately as well as for the naturally slouched group of the sample, and the results were similar. All one-sample t-tests returned significant results with large effect sizes (see Appendix H).

Table 3

Results of One-sample t-tests for 'Forced Choice Attractiveness' and 'Forced Choice Self-esteem'

Outcome	M	SD	n	Comparison Value	95% CI for Mean Difference	t	df	Cohen's d
Attractiveness	62.40	8.65	108	50	10.75, 14.05	14.89***	107	1.43
Self-esteem	66.62	9.44	108	50	14.82, 18.42	18.30***	107	1.34

*** $p < .001$.

2.3.4 Discussion

It was hypothesised that upright posture was perceived as more attractive and as reflecting higher self-esteem. Hypothesis 2 was supported, raters perceived upright posture as more attractive and higher self-esteem, suggesting that upright posture causes increased perceived attractiveness and perceived self-esteem.

3. General Discussion

3.1 Summary of Findings

This thesis aimed to examine the possible role of body posture as a valid cue to an aspect of underlying psychology – self-esteem –, and its association with attractiveness. Three hypotheses were proposed to investigate this relationship:

1. Upright posture will be perceived as more attractive
2. Upright posture will be perceived as higher self-esteem
3. Posture will mediate a relationship between self-reported self-esteem and perceived attractiveness/self-esteem.

The hypotheses were tested in two studies. The first study was a correlational design. The results from this study showed that bodies with naturally upright posture were perceived as more attractive and higher self-esteem, with moderate effect sizes. This was confirmed in the second analysis, the mediation model, where the effect of posture on rated attractiveness (or rated self-esteem respectively) was significant. However, the relationship between self-reported self-esteem and perceived attractiveness (or perceived self-esteem) was not significantly mediated by posture, since targets with higher self-esteem did not display a more upright posture. The hypothesis that posture mediates perceived attractiveness and self-esteem was therefore not supported. However, it is notable that correlations between rated attractiveness and rated self-esteem were the largest among all correlations. This could point to a potential perception bias, a halo effect of attractive people who are automatically assigned other good qualities, here high self-esteem (Zebrowitz & Montepare, 1992). In this context, it should be highlighted that standing upright is perceived as more attractive.

The second study was an experimental design to explore whether upright posture causes an increase in perceived attractiveness and self-esteem. As predicted, upright posture was perceived as more attractive and higher in self-esteem than slouched posture. The effect sizes were large, indicating the important role of posture in perceived attractiveness and self-esteem.

3.2 Findings in the context of previous literature

The findings are consistent with the two other studies that have examined the relationship between body posture and self-esteem (Korooshfard et al., 2011; Osborn, 1996). Korooshfard et al.'s (2011) study found that self-reported self-esteem correlates with rounded shoulders, which is an indicator of slouched posture. Another study investigated how much posture and make-up as self-presentation strategies could positively influence people's perceptions of attractiveness and personal attributes (Osborn, 1996). The different postures had a significant effect on the ratings, and overall, slumped posture was rated as less attractive than standard or military posture (Osborn, 1996). In addition, participants judged targets with slouched posture as possessing less desirable inner qualities (Osborn, 1996). Our results also show that an upright posture is perceived as more attractive, and that people associate a higher self-esteem with a more upright posture.

3.2.1 Posture is not a mediator for self-esteem. Although upright posture is perceived as more attractive and higher self-esteem, the hypothesis that posture would mediate a relationship between self-reported self-esteem and perceived attractiveness and self-esteem was not supported. This finding is contrary to the literature about the influence of emotional states on the body. Some studies have found that posture influences how people think, recall events, deal with stress, and how they evaluate themselves (Brinol et al., 2009; Kozak et al., 2014; Nair et al., 2015; Wilkes et al., 2017). Emotional states can also influence

a person's posture, which has been widely accepted in research regarding depression (5th ed., DSM-5, American Psychiatric Association, 2013; Do Rosário, Diógenes, Mattei, & Leite, 2013). Furthermore, the theory of embodied emotion suggests a reciprocal relationship between the body and mental states (Niedenthal, 2007). Based on the available research and the theory of embodied emotion, it could be expected that people with a higher self-esteem have a more upright posture.

However, the results do not confirm this notion. The mediation model shows that self-rated self-esteem predicts rated attractiveness and rated self-esteem, suggesting that observers can somewhat accurately detect self-esteem from photographs of bodies, and that people with higher self-esteem are perceived as more attractive. Posture also predicted perceived self-esteem and attractiveness, suggesting that people perceive upright posture as attractive and reflective of high self-esteem. However, the indirect effect of self-rated self-esteem on perceived attractiveness via posture was not significant, suggesting that posture may not serve as a valid cue to self-esteem. This result is unexpected. It could be that raters had a strong bias, perhaps obtained from cultural myths, toward assuming upward posture would indicate higher self-esteem while rating the photographs. This is reflected in study 2 where the raters found upright posture both more attractive and higher in self-esteem regardless of gender. If upright posture is perceived as more attractive and as higher in self-esteem without the rated person actually possessing a higher self-esteem, then posture is not a valid cue to self-esteem (Scott-Phillips, 2008).

A reason for this unexpected result could be that participants' postures were not affected by any inner state, but simply the result of either a strong or weakened posterior

chain[5] and limited mobility in the hip/low back and upper back due to habitual poor posture. Considering the low number of naturally upright standing participants, this could be a logical reason. Previous research has shown that a sedentary lifestyle leads to increased morbidity and mortality (Becka et al., 2017; Biswas et al., 2015; Lynch & Owen, 2015; Van Der Ploeg et al., 2012; Warren et al., 2010). The upper crossed syndrome[2] has become so commonly associated with texting that it has been named the 'text neck' (Acapo & Osinski, 2017; Fares, Fares, & Fares, 2017). It is sometimes referred to as non-specific neck pain (Fares et al., 2017).

This phenomenon was the most common postural problem observed during the stimuli collection phase for this thesis as only 13 percent of the 108 participants who had their photographs taken displayed a naturally upright posture. Other postural problems were for example, either leaning forward or backward, which only a few participants displayed (see examples in Appendix F). Incidences of the 'text neck' or head forward position which was measured via the three angles (neck, head, and shoulders) were alarming given the relative youth of the sample. The mean age of the group was 21, which suggests that most of the participants may have had frequent access to computers, tablets and mobile phones from late childhood or early adolescence. In addition, the sample mainly consisted of first year psychology students, which could indicate increased study time during their high school years to achieve admission to a sought-after undergraduate university course with a relatively high entry level. Research has supported the idea that increased study time contributes to the 'text neck' syndrome (Fares et al., 2017; Hakala, Rimpelä, Saarni, & Salminen, 2006).

[5] Muscles of the posterior chain include for example, the biceps femoris, gluteus muscles, erector spinae muscles, trapezius, and posterior deltoids.

Although the results suggest that posture is not a valid cue to self-esteem, it is important to recognise that raters judge both men and women as having higher self-esteem when they are shown in an upright posture. This conflicting result raises the question why people perceive posture as reflecting self-esteem, when the data suggests that it does not. It could be that an overgeneralisation effect is at play, which is common in social perception (Pound et al., 2014; Zebrowitz & Montepare, 1992). It could be that people automatically assume that others have a high self-esteem when they are attractive (Gupta et al., 2015; Ward & Scott, 2018). The 'beauty equals good' stereotype posits that people assign positive qualities to attractive persons (Dion, Berscheid, & Walster, 1972) and, since upright posture is perceived as attractive, it could be that perceived self-esteem is also impacted via the halo effect. Future research could investigate this effect further, and determine whether a halo effect exists with regards to attractiveness and self-esteem or if posture contributes to the halo effect.

Previous findings regarding the good genes theory could provide an explanation for why posture is perceived as attractive and high self-esteem while not being a valid cue to self-esteem. The good genes theory posits that physiological and psychological health is cued by a visibly healthy appearance, and that individuals exhibiting these cues are preferred as mating partners by members of the opposite sex (Andersson, 1994). In humans, following the 'good genes' hypothesis, evolutionary researchers suggested that attractive individuals are also physiologically and psychologically healthy (e.g. Coetzee et al., 2009). As outlined in the introduction of this thesis, results have been mixed with regards to attractiveness being a valid cue to physiological and psychological health (Pound et al., 2014; Rhodes, Zebrowitz, et al., 2001). For example, on the one hand, a study showed no relationship between childhood illness and symmetry (Pound et al., 2014). On the other hand SES, childhood adversities and nutrition was found to influence facial but not body symmetry (Hope et al.,

2013). Fathers' age at birth, income and educational status was also associated with facial attractiveness of their children, although more strongly in daughters than in sons (Huber & Fieder, 2014). One way of interpreting these results is that 'health' is a multi-dimensional concept, of which different aspects are predicted to be reflected in various face and body cues. It may be that posture does serve as a valid cue to some aspect of underlying physiological or psychological health, but that this aspect is not self-esteem.

As the good genes theory has shown mixed results with regards to human attractiveness, scholars posit that it may function more powerfully as an avoidance mechanism, rather than as an attraction mechanism (Pound et al., 2014). In this case, it may be suggested that low attractiveness serves as a valid cue to poor health, rather than high attractiveness serving as a valid cue to good health. For example, small deviations from perfect symmetry is still perceived as within the normal range, but extreme cases would be easily detected and avoided. This hypothesis was named the 'bad genes theory'. With regards to posture, extreme deviations from the natural upright posture appear not only from extreme slouched posture, but also from spinal deformations such as idiomatic scoliosis. The prevalence in Australia of idiomatic scoliosis is between one to ten percent (Longworth et al., 2014). There was one case in the sample of the targets with a severe scoliosis, and two cases with mild scoliosis. The incidences in this sample therefore fall within the Australian norm. It was not easy to detect the two mild cases of scoliosis in the sagittal plane. However, the deformation of the spine of the severe case was still visible on the photographs even for untrained raters, and ratings for this case were below average. With only one case in this study, it can only be speculated, but it may give an indication that people may also avoid extreme cases of spinal deformation just as they would avoid extreme cases of facial abnormalities. In this case, poor posture may serve as a valid cue to poor physiological or

psychological health. Further research could explore this question in more detail, and investigate whether posture is a cue to spinal health with an appropriate sample.

3.3 Importance of integrating body posture into evolutionary psychology research

This thesis was the first to investigate body posture within an evolutionary psychology context. It is therefore likely that the relationship between posture and self-esteem may not have been fully explored, and there may be unanswered questions that need further investigation. Further, exploring body posture and its relationship with self-esteem is important, because of the available longitudinal research, which identifies low self-esteem as a contributing risk factor for suicide, depression, teenage pregnancies, and victimisation (Chatard et al., 2009; Trzesniewski et al., 2006). Given that in the present study, raters rated people's self-esteem easily and consistently, future research could investigate the reasons for the consistency between different people's perceptions of upright posture as attractive and high self-esteem. As previous literature has shown, people make perceptual observations about emotions in others, and make inferences about self-esteem (Franzoi & Herzog, 1986; Pitterman & Nowicki, 2004; Zeigler-Hill et al., 2013).

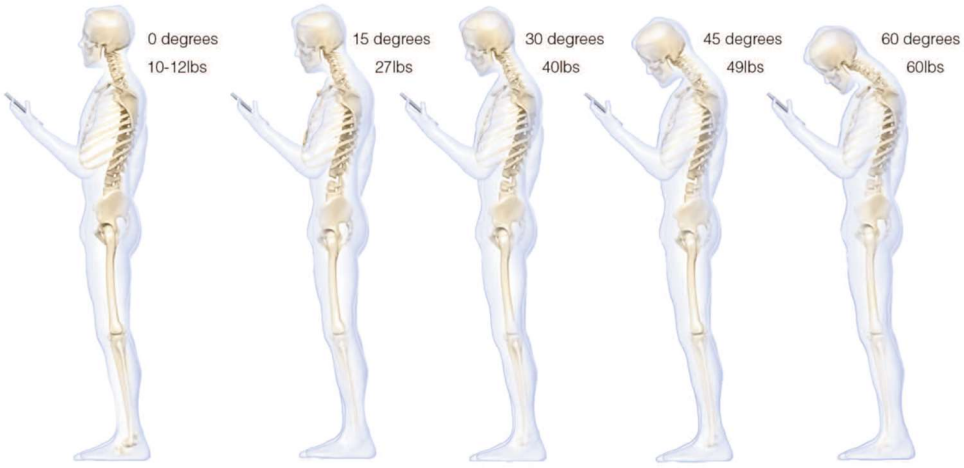
In the second study of this thesis, an experimental design was employed, and as predicted, raters perceived photographs depicting a person standing upright over the same person standing in their natural, slouched posture as higher in both attractiveness and self-esteem. In other words, when people see a person with an upright posture, they find this person more attractive and assume that this person has a higher self-esteem than a person with a slouched posture. Given that the effect sizes were large, this result may encourage further research into posture as a cue to attractiveness and psychological health. To our knowledge, this is the first study that investigates this concept in an experimental design.

Previous research has not examined posture as a cue to attractiveness, but used other body features such as BMI, waist-to-hip ratio (for women) and waist-to-shoulder ratio (for men) as variables (e.g., Brierley et al., 2016). A reason for this lack of interest may stem from the fact that posture can rapidly change, and is easier to fake than other cues such as BMI. It could be that the controversy surrounding power posing has deterred the research community to consider posture as a research topic (for a brief discussion see p. 17 of this thesis). Another reason could be that researchers believe that it is 'obvious' that upright posture looks better than slouched posture. As Gilman (2014) points out, almost every person heard the instruction to stand upright during childhood. However, other phenomena in evolutionary psychology are superficially obvious, but are still investigated by numerous researchers (and opposed by others). This applies especially concerning the attractiveness of faces, for example, symmetry or large eyes (see Stephen & Tan, 2015 for an overview). Another reason could be socio-historically based. Historically, upright posture was the very feature that distinguished humans from animals, and was considered important, which is reflected in the historical literature about upright posture as early as Aristoteles up until the 1950s (Gilman, 2014). However, during the youth revolution of the 1960s and '70s radical left politicians may have thrown out upright posture as stiff, fascist and antiquated (Gilman, 2014). This political shift initiated by the youth revolution could explain the decreased interest in 'good' posture in general, which could also be reflected in the research community. Only recently, mainly in the medical literature, the importance of an upright posture has again gained some traction due to alarming incidences of back pain and increased morbidity and mortality rates as a result of people's sedentary lifestyle (Becka et al., 2017; Biswas et al., 2015; Lynch & Owen, 2015; Van Der Ploeg et al., 2012; Warren et al., 2010).

Evolutionary psychology, as a relatively young sub-discipline of psychology, has triggered discussions about the origin of basic human behaviour. One of these is the question whether

beauty is socially constructed or has evolutionary roots (see for example, Esel & Polat-Esel, 2017; Hönekopp, 2006; Senior, 2003). Interestingly, with regards to posture, a similar argument exists. In a socio-historical review about the concept of posture, Gilman (2014) claims that upright posture is a socially constructed phenomenon. The author uses historical sources to build his argument. He posits that upright posture, and the plumbline measure stems from the attempt to produce uniform soldiers for military operations (Gilman, 2014). Despite this argument, the biomechanical efficiency of upright posture is striking. It makes sense to balance the heavy head, which typically weighs around five to six kilos, directly above the cervical spine instead of holding it in front of the centre line of gravity. As illustrated in Figure 7, the mechanical force on the cervical spine more than doubles at just 15 degrees head forward position (Hansraj, 2014). Although, historically, upright posture may have been promoted for soldiers, evolutionary influences could have driven the reasons behind upright posture being preferred for uniformity. For example, many very upright marching soldiers could have made an intimidating impression on the enemy or the public. It is important to note in this context that holding a naturally upright posture is not the same as assuming an exaggerated military posture or standing in a power posture (as suggested by Carney et al., 2010, but since been rejected). Holding a naturally upright posture is relatively effortless, if all muscles are working as they should. Difficulties in holding an upright posture arise from bad postural habits that compromise the musculature designed to keep one upright (Ishikawa et al., 2017). It would be worthwhile for evolutionary psychology to explore this topic further.

Figure 7



Position	Neutral	15°	30°	45°	60°	90°
Force to Cervical Spine	10-12lbs	27lbs	40lbs	49lbs	60lbs	Not Measurable

Impact of head forward position. *Biomechanical forces increase when the neck is flexed. The more the neck is flexed, the more weight is placed on the cervical spine. An adult head weighs between five to six kilos or 10-12 pounds in the neutral position. With increasing head tilt, the weight increases as well. For example, at 30 degrees, the cervical spine bears about 18 kilos or 40 pounds* (Graphic adapted from Hansraj, 2014).

3.4 Strengths

Contrary to previous research, this thesis was based on a methodologically sound stimulus collection phase as well as the use of both correlational and experimental methods. Previous studies, for example Korooshfard et al.'s (2011) study examined female students, and correlated a self-esteem scale with measurements of neck and shoulder angles. This study only used a correlational design, and the measurement technique for the neck and shoulder

angles involved palpating for bony prominences and the use of a goniometer, a device to measure angles, directly on the bodies of the participants. The measurements were performed and recorded by the experimenters in the presence of the subjects, which could have influenced the participants' natural, relaxed posture. The present study aimed to capture photographs of the natural, relaxed postures of participants, and then manipulate the photographs rather than measuring the participants' postures directly to avoid social desirability bias. Furthermore, contrary to Korooshfard et al.'s (2011) design, this thesis included male and female participants as well as male and female raters. The few previous studies assessing posture in relation to attractiveness used either only two models as stimuli (Osborn, 1996) or presented stimuli as line drawings (Gitter et al., 1982, 1983). The stimulus collection phase for this thesis was characterised by systematically eliminating as many confounding variables as possible. For example, participants wore provided tight fitting, grey shorts and singlets for the photographs, and were instructed to remove jewellery and make-up to reduce the influence of clothing and other self-enhancing strategies. The photographs were then further manipulated by blurring the faces and presenting the images in black and white to reduce the influence of skin colour and tone as well as hair colour and facial features. To obtain a natural stance despite being in an awkward environment, participants were told that the first couple of photographs were just to test the lighting for the camera. This instruction helped participants to relax and to stand in their natural posture waiting for the photographic session to officially start. Thus, the photographs that were taken first depicted the participants in their natural, relaxed posture, and the photographs that were taken second depicted the participants in their corrected posture.

Furthermore, participants completed their questionnaires about their self-esteem before being photographed. This was done deliberately to avoid any changes in mood or state due to being photographed in tight fitting shorts and singlets. In addition, the experimenter

only engaged in a conversation with the participants after they had finished the questionnaire as not to influence any internal state. Because the participants had to change into the provided set of clothes, it was an opportune time to strike up a light-hearted conversation while choosing the right sizes of clothes for each participant, so that they would feel as relaxed as possible for the photographic session.

Both studies, 1 and 2 were conducted under the same conditions. To avoid influencing raters' judgement, the experimenter only gave instructions about completing the study, and refrained from engaging in conversations with the raters. This was easily achieved, because the raters were organised in small groups to up to five raters, and talking was naturally kept to a minimum. Raters were randomly assigned to either study 1 or 2, and completed their respective study in 30 minutes or less, which avoided raters' attention fatigue. In addition, stimuli were presented in random order to prevent biased results due to viewing stimuli in a certain order.

BMI did not correlate with ratings of the photographs in terms of self-esteem. This finding is notable, because it shows the importance of posture over BMI in the perceptional judgement of self-esteem. More expected, BMI and rated attractiveness showed a significant correlation. Contrary to most studies about attractiveness of BMI, in this study, raters viewed photographs in the sagittal plane, which can amplify the appearance of abdominal fat on the one hand. On the other hand, it can also accentuate upright or slouched posture as it was intended for this study. Two studies that utilised posture as a cue to attractiveness also presented stimuli in the sagittal plane. The pictures showing a protruding abdomen were rated as least attractive (Gitter et al., 1982, 1983). However, both studies used line drawings as stimuli, which may have flawed the results (Gitter et al., 1982, 1983; Swami & Tovee, 2005). In general, women may be rated harsher than men, when showing a protruding abdomen

(Brierley et al., 2016; Gilman, 2014). Whether this is due to poor posture, abdominal fat, or a mechanism to detect pregnant women, remains to be investigated.

3.5 Limitations and Future Directions

The standardisation of the presentation of the stimuli was an emphasised feature of this research design. However, this strength could be a limitation at the same time, because it is unlikely that people stand without any movement in this posture for any length of time. It is more natural to stand with constant slight movements, which could include turning the head, changing the angle of the head, shifting body weight etc. Raters would not typically look at people in this stylised setup either. It is more natural that raters would rate other people while they are in motion. For example, watching others in the street, a café or bar would be a more naturalistic setting. However, the obvious problem in a naturalistic setting is the lack of standardisation. Future research could address these considerations by conducting research under different circumstances to achieve a balanced outcome between naturalistic and standardised settings. Another way to address the issue of small constant movements would be to use video footage instead of photographs. Participants could still wear uniform clothing, and their faces could be blurred, thanks to modern video editing technology. This idea has been recently put into practice in a study about facial symmetry where the researchers used video technology to capture the dynamic micro-movements in people's faces (Hughes & Aung, 2018). The same technology could be used in future studies about body posture.

Another limitation was the statistical power for the bodies' sample. It was assumed to have a sample of 82 participants to achieve a power of 80% power to detect small to medium effect sizes. Therefore, for the additional analyses separated by gender, the sample for each gender was slightly underpowered (females $N = 61$ and males $N = 47$). This could have

influenced the results. Therefore, the results concerning the analyses by gender only, should be interpreted cautiously. Future research could investigate the findings for gender differences with a larger sample.

A further limitation could have been the choice of the self-consciousness scales. The correlational results of study 1 have been unexpected with regards to the Private Self-consciousness scale (Buss, 1980). It was expected that the Private Self-consciousness scale would correlate with the other scales measuring self-esteem. In addition, no significant correlations were found between the Private Self-conscious scale with rated attractiveness and rated self-esteem. Self-esteem was defined as part of the self-regulatory process that constantly seeks to maintain or enhance one's self-concept by using behavioural and cognitive strategies (Rhodewalt & Tragakis, 2003), and it was assumed that questions regarding private self-consciousness would fit this definition. I.e., people would be self-aware and seek to correct one's self-concept. However, the results do not support this idea. Furthermore, the results also do not show significant correlations of either of the self-consciousness scales, private or public, with rated attractiveness and rated self-esteem, which may indicate that these two scales did not measure the aspects of self-esteem that were initially assumed. The youth of the sample could be an explanation why the self-consciousness scales returned unexpected results. Younger people may be not too concerned to go inward and think about their actions and projections into the world irrespective of their self-esteem. An indication for this argument was the correlation with age and self-consciousness in this sample. As age increased private self-consciousness increased as well, indicating that as people get older they are more self-aware. Further research could explore these questions in more detail.

In addition, future research could include questions relating postural problems and specifically explore neck or back pain, and strength and fitness to further examine this question. For example, possible research questions could relate to posture as a cue to spinal / back health, or include specific fitness tasks to investigate the role of posture in relation to muscle strength of the deep neck flexors, the rhomboids, erector spinae and postural stabilisers such as the psoas muscles, the deep core musculature for example the multifidi and transversus abdominus, and how this is perceived by untrained observers. Other questions could examine whether posture is related to either artificial cultural associations or to perceived social status.

3.7 Conclusion

This thesis aimed to fill a gap in the perception of attractiveness literature regarding the role of body posture as a valid cue to underlying physiology and psychology, namely self-esteem. Previous literature has mainly investigated the perception of attractiveness of faces. Attractiveness of bodies was predominantly researched with regards to size and shape such as BMI or hip-to-waist ratio. Other areas of interest in the field were gait and movement. Only a handful of studies had explored attractiveness of body posture and / or underlying psychological health. To our knowledge, this project is the first to use a combination of a correlational, mediation and experimental design. The results show that people find upright posture more attractive than slouched posture. There were also significant correlations between posture, perceived attractiveness and self-esteem. BMI was checked whether it correlated with the perception of self-esteem to avoid methodological limitations, and it was found to have no significant correlation with rated self-esteem.

However, the hypothesis that posture is a mediator in the relationship between self-reported and perceive attractiveness / self-esteem was not supported. Higher self-esteem on

the one hand does not necessarily mean that a person stands upright. On the other hand, lower self-esteem does not necessarily mean that a person stands in a slouched posture. An explanation for this finding could be that people have already developed bad postural habits with the accompanying weakening of key skeletal musculature. Considering that research about health implications of poor posture has only been conducted in other fields, research from an evolutionary psychology point of view is imperative to broaden the knowledge of the physiological and psychological health implications of poor posture.

Another explanation for this unexpected finding could be that people fall for the 'beauty is good' stereotype and associate a higher self-esteem with more attractive people. In addition, previous research has had mixed results when investigating valid cues to health from faces. This could suggest that health is not a one-dimensional construct, but a composite paradigm that is not easily measurable. Moreover, it has been proposed that humans may have evolved to detect unusual signs about each other. In that sense, people prefer others to be within a normal range, but not outside that range. For body posture, this could mean that people would detect others with unusually bad posture or spinal deformities, and avoid those people in their mate choices.

An implication for the wider community would be to be aware of subconscious decisions that people make about others. Working on one's upright posture could increase the mate value for the opposite sex. It has been suggested that exercise programs are efficient to decrease slouched posture and forward head position (Harman, Hubley-Kozey, & Butler, 2005). This has obvious health benefits but could also help to increase one's attractiveness ratings as well as at least appear to have higher self-esteem, even though people may not actually feel it. Additionally, maintaining a good posture could also be beneficial in other social settings, such as job interviews, presenting at business meetings or being introduced to

someone important. The advice ‘dress to impress’ could be extended to ‘stand upright to impress’.

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Appendices

Appendix A – Ethics approval letters

Ethics Approval for planned studies

Office of the Deputy Vice-Chancellor
(Research)

Research Services
Research Hub, Building C5C East
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4459
http://www.research.mq.edu.au/
ABN 90 952 801 237

MACQUARIE University
SYDNEY·AUSTRALIA

14 December 2017

Dear Dr Stephen,

Reference No: 5201700990

Title: *Posture and body perception*

Thank you for submitting the above application for ethical and scientific review. Your application was considered by the Macquarie University Human Research Ethics Committee (HREC (Human Sciences & Humanities).

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted by:

- Macquarie University

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007 – Updated May 2015) (the *National Statement*).

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement*, which is available at the following website:

http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All adverse events, including events which might affect the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol and associated documents must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

Ethics Approval Amendment for Stimulus production phase

07/11/2018 Macquarie University Student Email and Calendar Mail - HREC Application – Amendment Approved - 5201810893819 - Stephen

MACQUARIE University

EVA TZSCHASCHEL <eva.tzschaschel@students.mq.edu.au>

HREC Application – Amendment Approved – 5201810893819 – Stephen

1 message

donotreply@infonetica.net <donotreply@infonetica.net> 13 August 2018 at 11:10
To: ian.stephen@mq.edu.au
Cc: ian.stephen@mq.edu.au, eva.tzschaschel@students.mq.edu.au, daniel.sturman@mq.edu.au, joseph.antar@students.mq.edu.au, zoe.powell@mq.edu.au, fiona.lieu@mq.edu.au, edwina.keen@mq.edu.au, xin.cheng4@hdr.mq.edu.au

Office of the Deputy Vice-Chancellor (Research)

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CRICOS Provider No 00002J

MACQUARIE University
SYDNEY·AUSTRALIA

Dear Dr Stephen

RE: 5201810893819 - Objective face and body cues to health

Your amendment request has been approved.

You may access the application by logging into the Human Research Ethics Management System.

Kind regards,

Ethics Secretariat
Research Services| Level 3, 17 Wally's Walk
Macquarie University, NSW 2109, Australia

T: +61 2 9850 4459 (Administration)
T: +61 2 9850 7850 (HREC: Humanities and Social Sciences)
T: +61 2 9850 4194 (HREC: Medical Sciences)

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Appendix B – Consent Forms

Consent Form for Stimulus Production Phase

Department of Psychology

Faculty of Human Sciences

MACQUARIE UNIVERSITY NSW 2109

Phone: 02 9850 8001

Email: ian.stephen@mq.edu.au

Participant ID:

Chief Investigator's / Supervisor's Name: Dr Ian Stephen

Co-investigator's Names: Daniel Sturman, Joe Antar, Zoe Powell, Lewis Gould-Fensom, Fiona Lieu, Edwina Keen, Syed Jafar, Jena Cartwright, Peter Jonason, Eva Tzschaschel, Jordan Rogers, Phillip Cheng, Andrew Chen

Participant Information and Consent Form (phase 1)

Name of Project: Objective face and body cues to health

You are invited to participate in a study investigating the relationship between health and physical appearance. The purpose of the study is to examine how our health is reflected in our face and body.

This study is being conducted as part of a research programme led by Dr Ian Stephen (phone: 8950 8001, email: ian.stephen@mq.edu.au) of the Department of Psychology at Macquarie University.

If you decide to participate, measurements including your height and weight, waist circumference, chest circumference (males only), hip circumference (females only), body fat % and body muscle % will be recorded. Full length photographs will then be taken of you, wearing a pair of grey shorts and a grey singlet, in both 2D and 3D. You may be recognizable in your photographs. We will also use a harmless, painless and non-invasive device to measure your skin colour, and you will be asked to fill in a short questionnaire about your health behaviours.

The whole process should take approximately 60 minutes and for your participation you will receive 60 minutes of course credit, or receive $20 or go into the draw to win a $100 gift card. You will also be offered a copy of your 3D head image and a free app on which to view it.

What will happen to my data?

Your photographs will be used in HREC-approved studies related to the Visual Adaptation Model of Body Size Misperception Project by members of the body image and person perception research teams and their collaborators. This will include them being presented to participants who will be asked to make judgements of normality, health and attractiveness. If you consent, your images may also be used in future projects by members of the body image and person perception research teams and their collaborators.

Your data may be used in follow-up HREC-approved studies conducted by the members of the body image and person perception teams and their collaborators. However, it will not be possible to link your data to your name or contact details. No individual will be identified in any publication of the results.

Data and images will be kept on password-protected computers at all times (this will include the researchers' computers until October 2020). A summary of the results can be made available to you on request by emailing Ian Stephen.

Participation in this study is entirely voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence. If you decide to withdraw from the study we will honour this request and delete your photograph and you will still receive your incentive.

I, *(participant's name)* have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

☐ I consent to my images being used in future HREC-approved studies by the members of the body image and person perception teams and their collaborators.

☐ I consent to being invited to take part in future HREC-approved studies by the members of the body image and person perception teams and their collaborators.

Participant's Name:_____

(Block letters)

Participant's Signature: _____ Date:_____

Investigator's Name:_____

(Block letters)

Investigator's Signature: _____ __ Date:_____

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

If you have been distressed by any part of this experiment, support is available from Campus Wellbeing, Level 2, Lincoln Building (C8A), Macquarie University (telephone 02 9850 7497).

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

Consent Form for Studies 1 and 2

MACQUARIE University

Department of Psychology

Faculty of Human Sciences

MACQUARIE UNIVERSITY NSW 2109

Phone: 02 9850 8001

Email: ian.stephen@mq.edu.au

Participant ID:

Chief Investigator's / Supervisor's Name: Dr Ian Stephen

Co-investigator's Names: Eva Tzschaschel

The Body Image Study

PARTICIPATION INFORMATION AND CONSENT FORM

Dear Sir/Madam,

Thank you for considering participating in a research study about body image undertaken by Eva Tzschaschel (eva.tzschaschel@students.mq.edu.au). This research is being conducted to meet the requirements for the degree of Master of Research Psychology under the supervision of Dr Ian Stephen (ian.stephen@mq.edu.au) from the Department of Psychology. This is an important part of training as a researcher in the human sciences.

We are interested in how you perceive attractiveness and self-esteem from people's bodies. If you agree to participate, you will be asked to answer a short set of questions about how you perceive people's bodies. We expect that participating in this study will

take up to 30 minutes. In return for your participation, you will be awarded either 30 minutes' course credit or $10.

What will happen to my data?

Your data may be used in follow-up HREC-approved studies conducted by the members of the body image and person perception teams and their collaborators. However, it will not be possible to link your data to your name or contact details. No individual will be identified in any publication of the results.

Data will be kept on password-protected computers at all times (this will include the researchers' computers until October 2020). A summary of the results can be made available to you on request by emailing Ian Stephen.

Participation in this study is entirely voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence. If you decide to withdraw from the study we will honour this request and you will still receive your incentive.

I, (participant's name) have read (or, where appropriate, have had read to me) and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

□ I consent to my data being used in future HREC-approved studies by the members of the body image and person perception teams and their collaborators.

□ I consent to being invited to take part in future HREC-approved studies by the members of the body image and person perception teams and their collaborators.

Participant's Name:

(Block letters)

Participant's Signature: Date:

Investigator's Name: Eva Tzschaschel

(Block letters)

Investigator's Signature: Date:

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

If you have been distressed by any part of this experiment, support is available from Lifeline (13 11 14).

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

Dr Ian stephen
ian.stephen@mq.edu.au
Office Phone:02 9850 8001

Eva Tzschaschel
eva.tzschaschel@students.mq.edu.au
0414 612 369

Appendix C - Scales

Scales from the International Personality Item Pool (IPIP, 1992/2017): The Physical Attractiveness (Rational Scale; IPIP, 1992/2017; Goldberg et al., 2006), the Self-esteem scale (IPIP, 1992/2017; Rosenberg, 1965), and the Self-Consciousness (IPIP, 1992/2017; Buss, 1980)

Physical Attractiveness (Rational Scale) [Alpha = .87]

+ keyed	Am considered attractive by others.
	Attract attention from the opposite sex.
	Have a pleasing physique.
	Like to look at my body.
	Like to look at myself in the mirror.
	Like to show off my body.
– keyed	Don't consider myself attractive.
	Dislike looking at myself in the mirror.
	Dislike looking at my body.

Self-Consciousness (Buss, 1980)

Private Self-Consciousness [Alpha = .81]

+ keyed	Am constantly reflecting about myself.
	Examine my motives constantly.
	Look for hidden meaning in things.
	Try to examine myself objectively.
	Spend time reflecting on things.
	Like to get lost in thought.
– keyed	Don't try to figure myself out.
	Rarely look for a deeper meaning in things.
	Seldom daydream.
	Seldom get lost in thought.

Public Self-Consciousness [Alpha = .77]

+ keyed	Worry about what people think of me.

Want to amount to something special in others' eyes.

Feel threatened easily.

Need reassurance.

Need the approval of others.

Am easily intimidated.

– keyed Am not concerned with making a good impression.

Feel comfortable with myself.

Am not easily bothered by things.

Am not embarrassed easily.

Seldom feel blue.

Don't worry about things that have already happened.

Self-Esteem (Rosenberg, 1965) [Alpha = .84]

+ keyed Feel comfortable with myself.

Just know that I will be a success.

Seldom feel blue.

Like to take responsibility for making decisions.

Know my strengths.

– keyed Dislike myself.

Am less capable than most people.

Feel that my life lacks direction.

Question my ability to do my work properly.

Feel that I'm unable to deal with things.

The State Self-Esteem Scale (Heatherton & Polivy, 1991)

Items	**Sub-Scale**
1. I feel confident about my abilities.	Performance
2. I am worried about whether I am regarded as a success or failure. (R)	Social
3. I feel satisfied with the way my body looks right now.	Appearance
4. I feel frustrated or rattled about my performance (R).	Performance
5. I feel that I am having trouble understanding things that I read. (R)	Performance
6. I feel that others respect and admire me.	Appearance
7. I am dissatisfied with my weight. (R)	Appearance
8. I feel self-conscious. (R)	Social
9. I feel as smart as others.	Performance
10. I feel displeased with myself. (R)	Social
11. I feel good about myself.	Appearance
12. I am pleased with my appearance right now.	Appearance
13. I am worried about what other people think of me. (R)	Social
14. I feel confident that I understand things.	Performance
15. I feel inferior to others at this moment. (R)	Social
16. I feel unattractive. (R)	Appearance

17. I feel concerned about the impression I am making. (R)	Social
18. I feel that I have less scholastic ability right now than others. (R)	Performance
19. I feel like I'm not doing well. (R)	Performance
20. I am worried about looking foolish. (R)	Social

* R indicates reverse scoring

Appendix D – Buss Scales

Table 1

a) Results of bootstrapped Pearson's correlations for the Private and Public Self-consciousness Scales (Buss, 1980)

Scale	Physical Attractiveness	Rosenberg Self-Esteem	State Self-Esteem (overall)	State Self-Esteem (social)	State Self-Esteem (appearance)	State Self-Esteem (performance)
Private Self-Consciousness Scale	.005	-.110	-.062	-.085	-.062	-.006
	95% BCa CI [-.204, .200]	95% BCa CI [-.302, .084]	95% BCa CI [-.249, .119]	95% BCa CI [-.261,.078]	95% BCa CI [-.256,.126]	95% BCa CI [-.198,.194]
Public Self-Consciousness Scale	-.483***	-.553***	-.699***	-.682***	-.574***	-.511***
	95% BCa CI [-.622, -.324]	95% BCa CI [-.666, -.407]	95% BCa CI [-.779, -.606]	95% BCa CI [-.352, .075]	95% BCa CI [-.690, -.425]	95% BCa CI [-.631, -.372]

* p < .05; ** p < .01 *** p < .001.

Appendix E - BMI Correlations

Measure	Neck	Head	Shoulders	Rated Self-esteem	Rated Attractiveness
BMI	-.214* 95% BCa CI [-.368, -.030]	-.227* 95% BCa CI [-.405, .0028]	-.033 95% BCa CI [-.229, .176]	-.150 95% BCa CI [-.352, .075]	-.264**† 95% BCa CI [-.464, -.030]

Measure	Rosenberg Self-esteem Scale	Physical Attractiveness Scale	Private Self-consciousness Scale	Public Self-consciousness Scale
BMI	.065 95% BCa CI [-.108, -.233]	-.087 95% BCa CI [-.267, -.117]	.027 95% BCa CI [-.166, -.219]	-.104 95% BCa CI [-.297, -.113]

Measure	State Self-esteem Scale (SSES)	SSES Sub-scale 'Performance'	SSES Sub-scale 'Social'	SSES Sub-scale 'Appearance'
BMI	.121 95% BCa CI [-.065,.288]	.250** 95% BCa CI [.085,.404]	.161 95% BCa CI [-.026,.341]	-.139 95% BCa CI [-.318,.049]

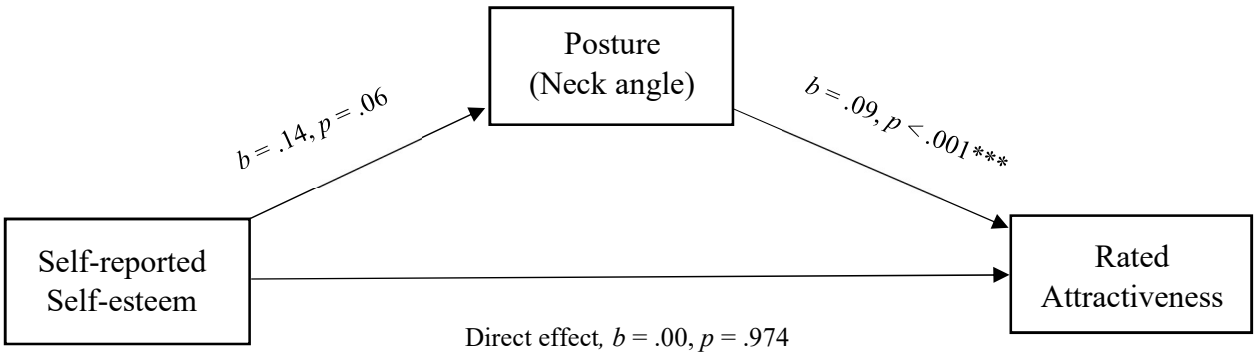
* p < .05; ** p < .01 *** p < .001.

Appendix F – Postural examples

Example for forward lean

Example for backward lean

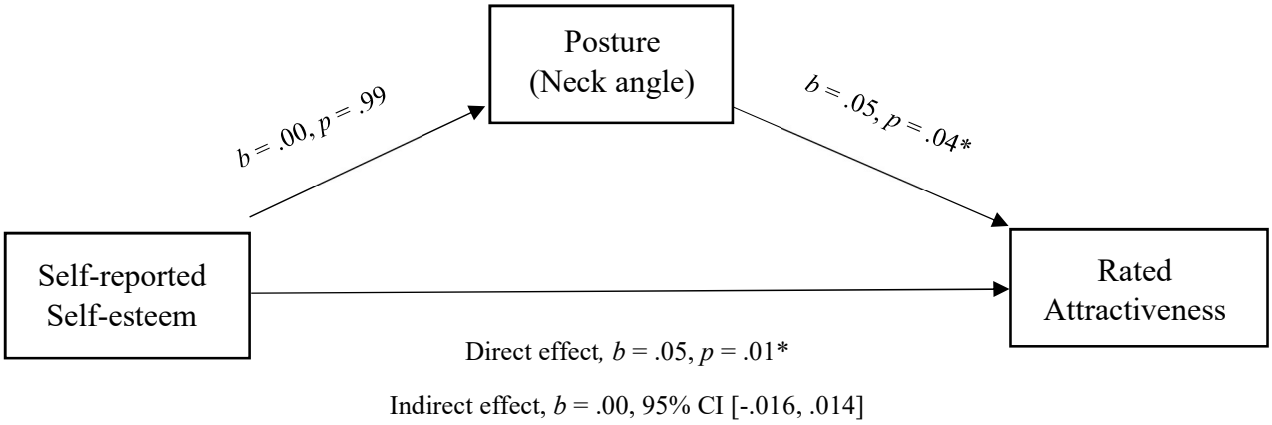
Appendix G – Supplementary Mediation Analyses



* p < .05; ** p < .01 *** p < .001.

Figure 1

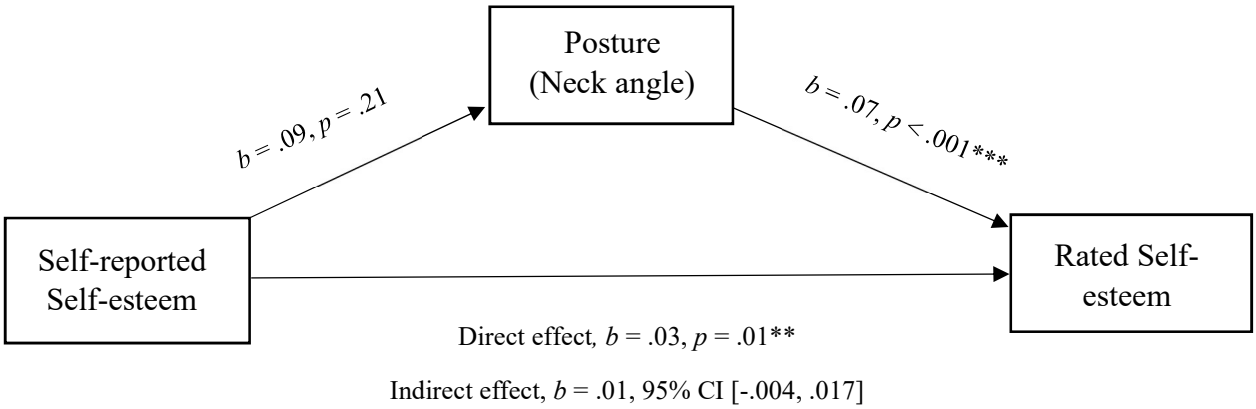
Regression coefficients for the relationship between 'Rated attractiveness' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant for the female sample.



* p < .05; ** p < .01 *** p < .001.

Figure 2

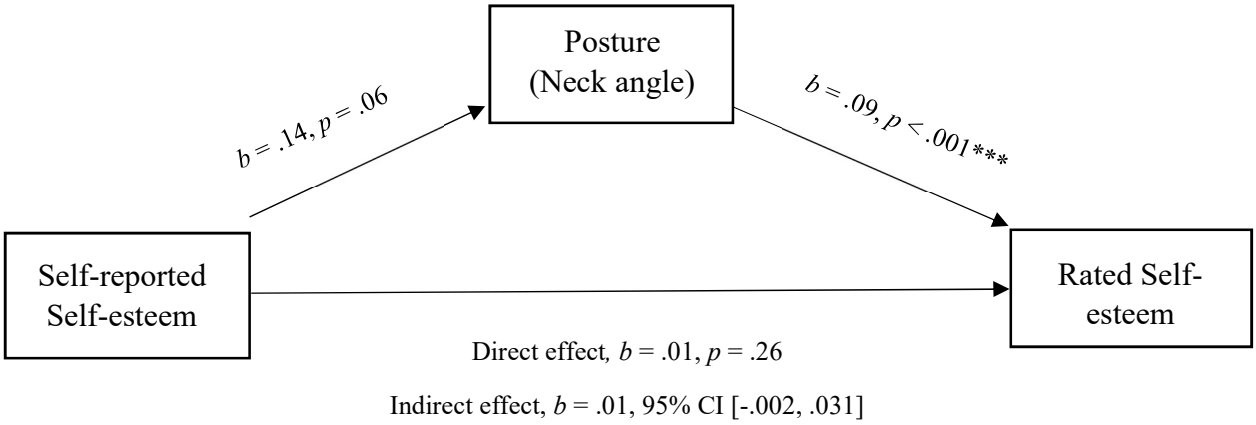
Regression coefficients for the relationship between 'Rated attractiveness' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant for the male sample.



* p < .05; ** p < .01 *** p < .001.

Figure 3

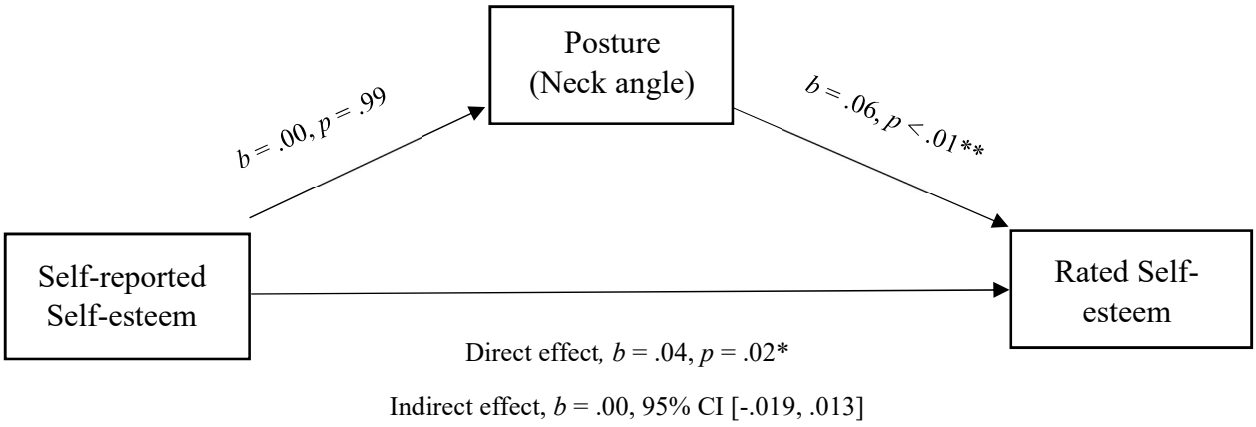
Regression coefficients for the relationship between 'Rated self-esteem' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant.



* p < .05; ** p < .01 *** p < .001.

Figure 4

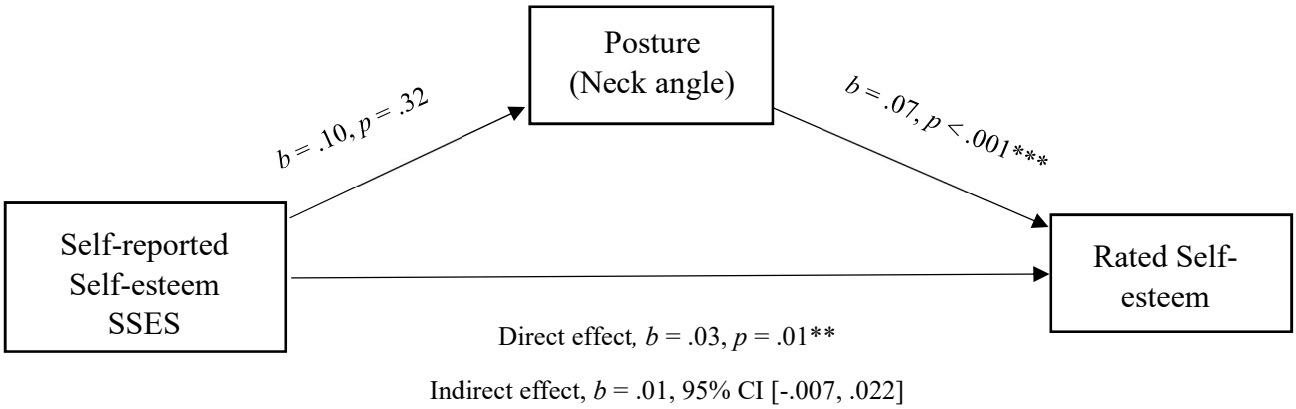
Regression coefficients for the relationship between 'Rated self-esteem' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant for the female sample.



* p < .05; ** p < .01 *** p < .001.

Figure 5

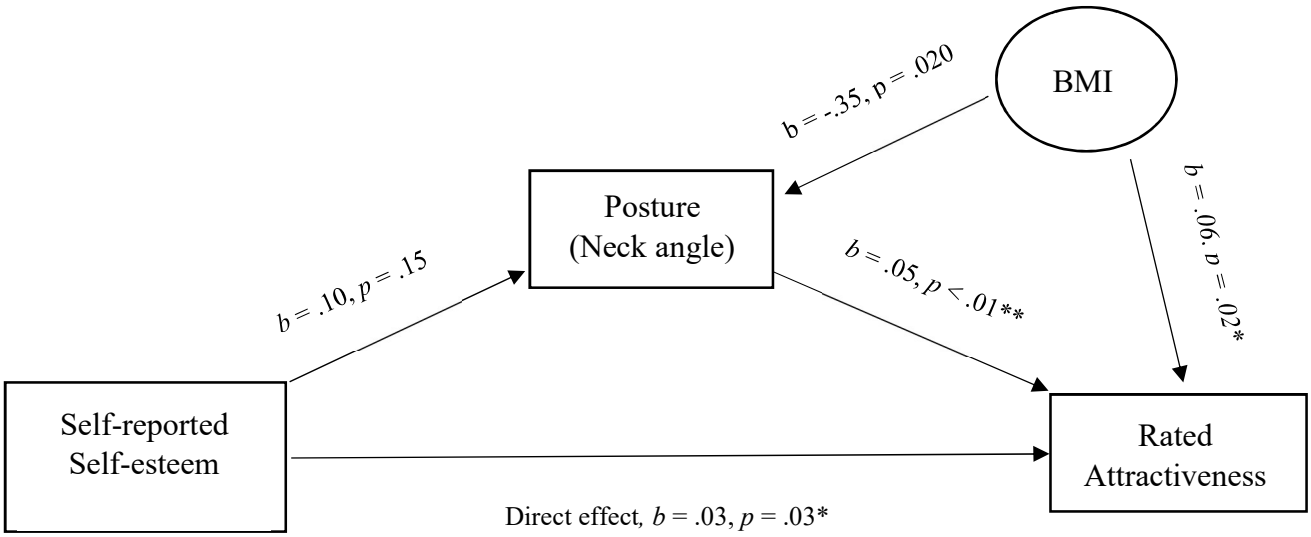
Regression coefficients for the relationship between 'Rated self-esteem' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)'. The indirect effect was not significant for the male sample.



* p < .05; ** p < .01 *** p < .001.

Figure 6

Regression coefficients for the relationship between 'Rated self-esteem' and 'Self-reported Self-Esteem' (SSES Appearance) as mediated by 'Posture (neck angle)'. The indirect effect was not significant.



* p < .05; ** p < .01 *** p < .001.

Figure 7

Regression coefficients for the relationship between 'Rated attractiveness' and 'Self-reported Self-Esteem' (Rosenberg, 1965) as mediated by 'Posture (neck angle)' including BMI as a co-variate. The indirect effect was not significant.

Appendix H – One sample t-tests

Table 1

Results of One-sample t-tests for 'Forced Choice Attractiveness' and 'Forced Choice Self-esteem' Females

Outcome	M	SD	n	Comparison Value	95% CI for Mean Difference	t	df	Cohen's d
Attractiveness	62.63	7.95	61	50	10.59, 14.67	12.41***	60	1.59
Self-esteem	67.28	7.96	61	50	15.24, 19.32	16.96***	60	2.17

*** p < .001.

Table 2

Results of One-sample t-tests for 'Forced Choice Attractiveness' and 'Forced Choice Self-esteem' Males

Outcome	M	SD	n	Comparison Value	95% CI for Mean Difference	t	df	Cohen's d
Attractiveness	62.11	9.57	47	50	12.11, 9.29	8.67***	46	1.27
Self-esteem	65.77	11.10	47	50	15.77, 12.51	9.47***	46	1.42

*** p < .001.

Table 3

Results of One-sample t-tests for 'Forced Choice Attractiveness' and 'Forced Choice Self-esteem' for slouched participants only (naturally upright participants were removed)

Outcome	M	SD	n	Comparison Value	95% CI for Mean Difference	t	df	Cohen's d
Attractiveness	61.48	7.34	93	50	9.97, 13.01	15.09***	92	1.56
Self-esteem	65.74	6.94	93	50	14.31, 17.17	21.88***	92	2.29

*** $p < .001$.