Male musculature preferences and manipulation of such preferences in men, women, boys and girls

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Abstract

Western media overemphasises and unrealistically portrays idealised bodies. The literature exploring how such images can alter body type preferences has focused almost exclusively on women and their preferences for the thin female body ideal, whilst equivalent work on men and male muscularity has been neglected. In response to this, we ran nine studies which sought to address this gap in the literature, of which seven specifically explored the visual diet effects of high and/or low muscle male body exposure on one's preferences for muscularity. Studies 1 and 2 examined whether viewing high (low) muscle mass male bodies could increase (decrease) preferences for muscularity in men and women, whether a man's drive for muscularity could predict the strength of this effect, and whether 'visual diet' or 'associative learning' mechanisms best explained any changes in preferences. We found evidence for changes in musculature preferences in the direction of the prevalent image type, and concluded that the visual diet and associative learning hypotheses could both, to some extent, explain such shifts in musculature preferences. Study 3 was conducted in response to the criticism that existing body exposure work involves stimulus presentation that could lead to demand characteristics. Findings revealed musculature preference shifts could still be observed even when manipulation conditions were less obviously skewed towards a particular body type. Study 4 sought to replicate any musculature preference shifts observed in Studies 1-3, whilst also examining whether men's pre-existing internalisation of cultural body ideals and perceived pressures to achieve such ideals (as measured by the Sociocultural Attitudes Towards Appearance Questionnaire; SATAQ-4) could moderate susceptibility to such effects. We found that viewing high (low) muscle mass male bodies increased (decreased) musculature preferences and that this was moderated by SATAQ-4 scores in men but not women. Studies 5, 6 and 7 were three overlapping studies involving 6-18-year-old boys and girls. Study 5 examined the age profiles of SATAQ-4 and Drive for Muscularity (DMS) scores. Study 6 tested whether children's preferences for high/low muscularity images could be manipulated via viewing biased selections of stimuli, and whether age, SATAQ-4 and/or DMS scores predicted susceptibility to such effects. Study 7 required participants to provide free-text responses

regarding their perception of images of men high or low in muscularity. Findings revealed that age positively predicted SATAQ-4 scores (for boys and girls), and DMS scores (boys only) in Study 5, and, in Study 6, age positively predicted boy's and girl's baseline preferences for muscularity. Study 6 also revealed evidence of musculature preference shifts following body viewing, but there was an interaction with age and gender. Notably, it was only the older 15–18-year-old boys who showed evidence of such effects when data was broken down by gender and age, with no such age effects present for the girls. Study 7 showed that across the different age groups boys and girls described high (low) muscle mass media figures in similar ways. For the final two studies, we used the dot probe paradigm (Study 8) and eye tracking (Study 9) to investigate a bias in visual attention towards high (over low) muscle mass male bodies. We found both men and women showed such a bias in visual attention, and internalisation of cultural body ideals, pressures to achieve such ideals, and one's drive for muscularity were found to predict this bias in attention. Additionally, Study 8 revealed evidence for significant musculature preference shifts following image viewing amongst those men who had strongly internalised the muscular body ideal. Overall, the findings of this thesis have important implications as they indicate that preferences for male muscularity in men, women, boys and girls can, much like one's preference for the thin body ideal in females, be affected by one's visual diet. The muscular male body ideal that dominates much of Western media may therefore be perpetuating, maintaining, and/or intensifying unrealistic standards of the male body in those who consume such media.

Table of contents

List of tables

List of figures

Declaration

The content of this thesis has not previously been submitted as part of any other degree, nor has it been submitted concurrently for any other degree.

This thesis is the result of my own independent work except where otherwise indicated. Material from other sources has been acknowledged and full references are provided.

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Submitted work

Study 4, which is presented in Chapter 3, has been submitted for publication as part of a larger paper. Chapter 3 is an adapted form of that submitted paper.

Publications

The paper presented in Chapter 2 was accepted for publication in August 2021 and is presented in published form, though is formatted to align with the overall formatting requirements of this thesis. The corresponding reference is:

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Dedication

Born during my third year of study, this thesis is dedicated to my son, Reuben.

Chapter 1.

General introduction

1.1. Brief description of the literature presented in this chapter and the current project aims

The work presented in this literature review will be interpreted in the wider context of the PhD project. This thesis seeks to examine whether the viewing of idealised bodies, like those depicted in Western media, can change musculature preferences of male bodies in men, women, boys and girls. It also explores whether one's drive for muscularity, internalisation of cultural body ideals, perceived sociocultural pressures to achieve such ideals and/or any bias in visual attention towards muscular male bodies may make one more susceptible to such musculature preference changes. This literature review will highlight the understudied areas of male body image and body preference research, identifying unanswered questions which will then provide the focus for the empirical chapters of this thesis. A rationale for the chosen methodologies will also be included as well as the presentation of the research aims and hypotheses for each of the four empirical chapters.

As will be outlined within this thesis, the literature exploring body ideals has focused almost exclusively on women, examining their female body type preferences in relation to BMI and/or body fat mass. From the less extensive literature on men and their male body type preferences, much of the research has again focused on the thin ideal, generally failing to explore male muscularity preferences despite this being a key aspect of male body image. The research presented in the empirical chapters of this thesis therefore seek to examine preferences for muscularity in male bodies and whether these preferences can be manipulated by exposing participants to images of men that vary in muscle mass, exploring whether visual diet and/or associative learning mechanisms best explain any preference changes. The research also builds upon current body preference literature by exploring whether men who show a strong drive for muscularity, strong internalisation of cultural body ideals and/or heightened perceived pressure to achieve such body ideals are more susceptible to their musculature preferences being manipulated. Further, the work presented examines drive for muscularity, internalisation of cultural body ideals and perceived pressure to achieve such ideals across childhood and adolescence, exploring whether certain age groups' musculature preferences are more malleable than others. Finally, the empirical chapters seek to investigate whether individuals are more likely to visually attend to high muscle mass males over low muscle mass males, as well as whether one's drive for muscularity, internalisation of cultural body ideals and pressures to achieve these ideals could predict such a bias in visual attention which could then lead to stronger musculature preference changes in these individuals.

The current literature review is intended to provide a general overview of work on (1) Men's preoccupation with muscularity and the sociocultural pressures associated with this, focusing predominantly on the influence of Western media; (2) The effects of body type exposure on perceptions of normality and body type preferences, including the relationship between pre-existing body image concerns as a predictor of any perceptual changes; and (3) Body image concerns, preferences for muscular male body types, and Western media influences throughout childhood and adolescence.

1.2. Body image

1.2.1. What is body image?

Body image refers to one's perceptions, feelings and thoughts about their own bodies (Grogan, 2021). There are four main aspects of body image; the way one sees their body (perceptual), the way one feels about their body (affective), the thoughts and beliefs one may have about their body (cognitive), and the behaviours one may exhibit because they are dissatisfied with their body (behavioural) (McCabe & Ricciardelli, 2004). Most body image research focuses exclusively on the construct of body dissatisfaction which is the subjective negative evaluation of one's own body (Grogan, 2021). Body dissatisfaction is driven by the internalisation of cultural body ideals, with Western media conveying a thin ideal for female bodies (e.g., Fouts and Burggraf, 1999; Mastro, & Figueroa-Caballero, 2018), and a lean, muscular ideal for male bodies (e.g., Boyd & Murnen, 2017; Dallesasse & Kluck, 2013; Law & Labre, 2002; Leit, Pope, & Gray, 2001; González et al., 2020;

Pope et al, 1999). Internalisation of such ideals, and their association with body dissatisfaction, can explain the high prevalence of eating disorders driven by the pursuit of thinness in women (e.g., Cafri et al., 2005; Shaefer, Burke & Thompson, 2019) and the drive for muscularity in men (e.g., Klimek et al., 2018). In some cases, a man's preoccupation with muscularity and leanness can lead to a diagnosis of muscle dysmorphia, a sub-category of body dysmorphia classified in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013) where one possesses a pathological preoccupation with muscularity and leanness (Pope et al., 1997).

1.2.2. The neglected field of male body image

Historically, it has been *women's* body image concerns, and their preferences for the thin body ideal, that has been the focus of body image research. This may be because such literature has its roots in clinical psychology and psychiatry which has emphasised the pursuit of the thin ideal, with recent reviews revealing that women are more likely than men to be diagnosed with eating disorders driven by a desire to be thin (e.g., Galmiche et al., 2019; van Eeden, van Hoeken & Hoek, 2021). Further, the research spotlight has likely remained on women because of the notion that men's levels of body dissatisfaction may not be as high as women's (e.g., Quittkat et al., 2019). Whilst such research has left the study of male body image somewhat neglected in comparison to equivalent work on women, researchers have started to become increasingly more interested in male body image and men's pursuit of the muscular body ideal specifically, with muscularity now recognised as a key aspect of male body image (e.g., McCreary et al., 2004; Pope, Phillips & Olivardia, 2000). Indeed, as will be outlined below, men, much like women, can be dissatisfied with their bodies and can face pressure to achieve an idealised body.

It has been argued that male body image concerns have, under some research paradigms, been underrepresented because men find it difficult to express such concerns in front of others and feel they must conceal them (e.g., Adams, Turner & Bucks, 2005; Pope et al., 2000). Both men and women acknowledge the 'social taboo' in men discussing their body image issues (Diedrichs, Lee and Kelly, 2011), with boys as young as 14 conceding their physical appearance to be more important than they would like to admit. Males may be reluctant to voice their body image issues in front of others for fear of being considered 'feminine' or 'gay' (Hargreaves & Tiggemann, 2006) or because this would violate hegemonic notions of masculinity (Bennet & Gough et al., 2013; Lee & Owens, 2002). Jankowski et al (2018) found men often minimised their body dissatisfaction during intervention (e.g., one participant stated 'I honestly can't think of [any appearance pressure] that annoys me'), but would indicate later that they were, in fact, impacted by the ideal (e.g., the same participant later stated 'my worst thing would be [to be] overweight, that's what I worry about most'). Notably, whilst the body positivity movement has gained traction with women, male body positivity has not received as much focus (e.g., Thompson & McKinney, 2020). Therefore, although women may feel they can be more candid about their body image concerns and may consciously learn to reject the often unattainable and narrowly defined body ideals that are instilled within society, this may not always be the case for men. This, with men's concealing and minimisation of their body image concerns, and their desire to conform to hegemonic notions of masculinity, could result in male body image issues going unrecognised and being underrepresented in research findings.

When men are asked to reveal body image concerns anonymously, however, their body dissatisfaction appears to be more prevalent, which may be because they feel they can be more candid in such contexts. For example, using a cross-sectional anonymous survey, Fallon, Harris, and Johnson (2014) reported that the prevalence of body dissatisfaction amongst US men ranges between 9.0% to 28.4%, which closely mirrors the prevalence statistics for women (13.4% to 31.8%). Similarly, a study on 735 adolescents aged 11-15 revealed that a considerable proportion of the boys (44.7%) admitted to experiencing some level of body dissatisfaction, which was *higher* than the proportion of girls admitting to this (40.2%) (McLean et al., 2022). Other measures of body dissatisfaction include the use of silhouette rating tasks (e.g., Frederick et al. 2007) which have revealed that from the 68 male US students studied, 90% of them were dissatisfied with their levels of muscularity and wanted to be more muscular. More recent research, where 1834 Australian adolescent boys provided anonymous survey responses, revealed the 2022 point prevalence of muscle dysmorphia to be 2.2% which is considerably higher than the point prevalence documented for other related conditions including obsessive compulsive disorder, anorexia nervosa and bulimia nervosa (Mitchison et al., 2022), showing that body dissatisfaction and preoccupation with the muscular body ideal is becoming an increasingly pressing issue for males. Indeed, a survey by Garner (1997) confirmed that men's dissatisfaction with their bodies increased from 1972 through to 1997, with dissatisfaction with the overall appearance of their body almost tripling (15% to 43%) in this time frame. The next section of this thesis will engage with the question of *why* men's body dissatisfaction may be increasing.

1.2.3. The 'Adonis complex'

In 2000, Pope, Phillips and Olivardia introduced the idea of the 'Adonis complex', a term they used to describe the anxiety and insecurity experienced by boys and men in relation to their preoccupation with their appearance and achieving an idealised muscular physique (Pope, Phillips & Olivardia, 2000). In extreme cases, they argue the complex can meet criteria for body dysmorphic disorder and, as previously noted, the fifth edition of the DMS-5 (American Psychiatric Association, 2013) now classifies 'muscle dysmorphia', the excessive preoccupation with muscularity and distorted perception of one's body size, under body dysmorphia, thus recognising it as a psychiatric disorder.

Pope and colleagues posit that men's body dissatisfaction and preoccupation with the muscular body ideal is becoming increasingly common in boys and men than has historically been the case (Pope, Phillips & Olivardia, 2000), and they argue this is related to two sociocultural changes in recent generations: i) The availability of anabolic steroids and ii) Increasing gender equality.

1.2.3.1. The discovery of steroids and the impact on male body image

As Pope, Phillips and Olivardia (2000) put it, the discovery of steroids has allowed men to 'break through his normal biological ceiling of muscularity' (p. 35) and achieve a level of muscularity that would be unattainable through natural means. The discovery of steroids meant that hyper-muscular male bodies, with levels of muscularity that would be impossible to achieve naturally, started to infiltrate Western media, shaping societal body ideals for men. Authors argue that no previous generation in history has ever been exposed to the hyper-muscular bodies that are now prevalent as part of everyday visual diet, and this may be instilling new, often unattainable body standards for men.

1.2.3.2. Gender equality and an increased preoccupation with building muscle mass

Furthermore, Pope and colleagues suggest that increasing gender equality may have contributed to men's preoccupation with muscularity. They argue that male body image, and men's levels of muscularity in particular, has become increasingly important in defining one's masculinity. They state that eroding traditional gender roles means that women are now less dependent on men for money and power, and thus one of the few ways men can continue to assert their masculinity is through their muscularity (Pope, Phillips & Olivardia, 2000). Indeed, the male body ideal depicted in Playgirl magazines (Leit, Pope, & Gray, 2001) and children's action toys (Pope et al., 1999; Baghurst et al., 2006) does appear to have grown increasingly *more* muscular overtime and seems to be increasing in parallel with what Pope, Phillips and Olivardia (2000) refer to as 'feminist milestones'. The parallels in timing between these 'feminist milestones' and increased emphasis on male muscularity, however, clearly do not prove a causal connection, and authors acknowledge that men were likely experiencing body image concerns and drive for muscularity long before the push for gender equality. Thus, the next section of this thesis will engage with other sociocultural pressures that may be contributing to men's preoccupation with muscularity.

1.3. Men's preoccupation with muscularity: sociocultural pressures

The muscular male body ideal is thought to prevail because of the sociocultural pressures men face to achieve such a physique. Sociocultural models, including the tripartite model (van den Berg et al., 2002), predict that men's body image issues and preoccupation with the muscular body ideal arise as a result of perceived pressure from other people (e.g., peers and/or family) and/or through the depiction of idealised body types that prevail in Western media.

1.3.1. Pressure from others

Men may feel pressure to achieve the body ideals that are valued within one's peer group. Men view muscularity as a desirable trait to possess (Tiggemann, Martins & Kirkbride, 2007), and those men who possess a muscular physique are rated as physically strong (Sell et al., 2009), and evoke feelings of jealousy (Dijkstra & Buunk, 2001) in other men. A large chest and small waist is the primary component of male attractiveness as rated by other males (Swami & Tovée, 2008) and men show a clear preference for high muscle mass, low adiposity male bodies, especially if they have internalised the cultural ideal for muscularity (Ridley et al., 2022). Moreover, in focus groups, teenage boys as young as 16 have admitted to feeling pressure from their male peers to achieve a muscular physique (Grogan & Richards, 2002).

As well as pressures from their male peers, men may also face pressures from women to achieve a desirable physique. In focus groups, for example, Australian men reported that comments from their partners (or potential partners) influenced the evaluation of their own attractiveness which then influenced their body image (Fawkner, 2004) and in semi-structured interviews men reported that dissatisfaction with their bodies stemmed from negative feedback form others, especially so when this came from their sexual partners (Adams, Turner & Bucks, 2005).

The female mate choice literature, with its focus on evolutionary drives, provides further evidence for the notion that, via female preferences for masculinity, men can feel pressure to achieve a muscular physique. Such evolutionary work has focused on women's preferences for masculinity as portrayed in men's faces (e.g., Docherty et al. 2020; Lei, Holzleitner & Perrett, 2019), voice pitch (Apicella, Feinberg & Marlowe, 2007; Feinberg et al., 2006), scents (Thornhill, Chapman & Gangestad, 2013) and behaviours (Gangestad et al., 2004; Sadalla, Kenrick & Vershure, 1987). The literature exploring women's preferences for masculine male body types, however, has been neglected in comparison. Though, research has shown that women who prefer masculinised features in one domain, for example in masculine faces, are also likely to prefer masculinised features in other domains, for example, in their body types (Zhang, Zheng & Zheng, 2018). From the limited literature that does exist on women's male body type preferences, it seems that, on average, women prefer high muscle mass low adiposity male bodies (Dixson et al., 2014; Ridely et al., 2022), rating them as sexier and more physically dominant than lean or heavily-set men (Frederick & Haselton, 2007). Moreover, women's perception of men's physical strength determines over 70% of their bodily attractiveness (Sell, Lukazsweski & Townsley, 2017), with low waist to chest ratios (WCR) in men (associated with a muscular inverted triangle body shape) a better predictor of men's attractiveness to women than both waist to hip ratio (WHR) and BMI (Tovée et al., 1999). Men from different cultural backgrounds (American, Ghanaian and Ukrainian men) share the belief that women prefer muscular male bodies and these men desire muscularity for their own bodies (Frederick et al., 2007) which crucially supports the notion that men are *aware* of women's preferences for muscularity. Furthermore, although based on self-report, muscular men are more likely than less muscular men to rate their bodies as sexier to women and report more affairs with partnered women, and more lifetime and short-term sexual partners (Frederick & Haselton, 2007), as well as a higher number of total and past-year sex partners and earlier age at first sexual intercourse than less muscular men (Lassek, & Gaulin, 2009). Such research shows muscularity could be associated with an increased mating and reproductive advantage in men and this, in turn, may increase the pressure men feel to achieve a muscular physique themselves. Specifically, men may feel they need to achieve muscularity as a means to outcompete other males (intra-sexual selection) such that they can appeal to women (inter-sexual selection). Indeed, Lidborg, Cross and Boothroyd's (2022) recent meta-analysis revealed that from six different measures of masculinity, it was only strength/muscularity that predicted both mating and reproductive outcomes for men. Such work shows that, at least from an evolutionary point of view, muscularity is an important sexually dimorphic trait for men to possess.

The evolutionary explanations here are, on their own, not sufficient enough to explain men's preoccupation with muscularity given the recent upward trend in male body dissatisfaction (e.g., Garner, 1997). With the increasing prevalence and accessibility of Western media, and its depiction of muscular males, one would expect this sociocultural factor to, perhaps in parallel with evolutionary pressures, be shaping women's preferences for males of this body type, as well as driving the pressure men feel to achieve such a physique. The next section of the thesis will therefore examine Western media's impact on preoccupation with male muscularity.

1.3.2. How Western media affects preferences for male muscularity and male body image.

1.3.2.1. Western media and the muscular ideal

Since the late 1980's there has been a significant increase in the visibility and marketability of the male body which could be increasing body image pressures amongst men (Grogan, 2021). Mort

(1988), for example, noted the increasing prevalence of high muscle mass male bodies in British media. Western media perpetuates body size ideals, with such imagery typically overemphasising and unrealistically portraying idealised body types. Female media figures often possess low BMIs (Fouts and Burggraf, 1999; Mastro, & Figueroa-Caballero, 2018). Whereas, for male media figures, it is the muscular body ideal that prevails, and this is evident in toy action figures (Boyd & Murnen, 2017; Pope et al, 1999) in magazines (Law & Labre, 2002; Leit, Pope, & Gray, 2001), in reality tv shows (Dallesasse & Kluck, 2013) and in animated films (González et al., 2020). These idealised muscular male bodies dominate one's visual diet and typically possess positive associations, for example they are often perceived to exude strength (Drummond, 2011; Gonzalez et al., 2020) and sexual success (Morrison & Halton, 2009). They present body standards that are often difficult to achieve oneself and fail to represent what is average amongst members of the population (Baghurst et al., 2006; Pope et al., 1999). The increasing accessibility of Western media, and its portrayal of unrealistic body standards may, to some extent, explain why body dissatisfaction is increasing in men worldwide, with more TV viewing and greater media internalisation associated with low body appreciation and a more muscular body ideal amongst men from both WEIRD (Western, Educated, Industrialized, Rich, Democratic) and non-WEIRD populations (Thornborrow et al., 2020). According to socio-cultural theory (Thompson et al., 1999a), it is the internalisation of Western media's masculine, muscular body ideal that is contributing to poor body esteem (Obeid et al., 2017) and muscle dysmorphia symptoms (Klimek et al., 2018) in men.

1.3.2.2. The effects of viewing such idealised muscular bodies depicted in media

Historically, the idealised bodies depicted in Western media imagery were thought to have more of a negative impact on body satisfaction in women than in men (Smolak, Levine & Thompson, 2001). Recent evidence, however, suggests that men, like women, *do* still experience negative effects of idealised media on body image but are reluctant to admit this in front of others in group settings (e.g., Adams, Turner & Bucks, 2005: Diedrichs, Lee & Kelly, 2011; Hargreaves & Tiggemann, 2006; Pope et al., 2000). As previously mentioned, Jankowski et al. (2018) found that whilst men minimised the existence of their own body dissatisfaction and the influence the appearance ideal had on them personally, in later self-reports, and despite earlier minimisation, the same men stated the substantial impacts that this body dissatisfaction had had on their health behaviours, psychological well-being, and social interactions. Moreover, Aubrey (2006) found exposure to sexually objectifying television and magazine media figures increased body surveillance for men and *not* women, suggesting that men could in fact be more susceptible than women to media effects in some contexts, highlighting the need for more work into this neglected area of study.

Research has shown that the viewing of idealised, muscular male bodies can result in such bodies being perceived as more ‘normal’ than less muscular male body types, creating unrealistic body standards for men (Brooks et al., 2020a; Sturman et al., 2017). This may explain the correlational evidence between media use and body dissatisfaction in men (Schooler & Ward, 2006) and the experimental evidence that body dissatisfaction in young men can be increased by viewing athletic, muscular male media images from TV and magazines (Blond, 2008; Cramblitt & Pritchard, 2013; Duggan & McCreary, 2004; Hargreaves & Tiggemann, 2009; Hatoum & Belle, 2004; Hausenblas et al., 2013; Leit et al., 2002; Lorenzen et al., 2004; Morry & Staska, 2001), video games (Barlett et al., 2008; Sylvia et al., 2014), music videos (Mulgrew & Volcevski-Kostas, 2012; Mulgrew & Cragg, 2017), and superhero movies (Young, Gabriel & Hollar, 2013). Even simply handling muscular action figures for 30 minutes can lead to decreased body esteem in young adult males (Barlett et al., 2005). Aside from increased body/muscle dissatisfaction, those viewing idealised male bodies in advertisements also become significantly more depressed than those who are exposed to neutral advertisements (Agliata & Tantleff-Dunn, 2004). Furthermore, Daniel and Bridges (2010) lend support to the idea that it is the internalisation of media ideals that is the strongest predictor of the drive for muscularity in men, and that messages in the media concerning muscles can predict levels of body dissatisfaction, especially in those men with low self-esteem (Ricciardelli & McCabe, 2001a). Reviews and meta-analyses that involve both survey and experimental research (Barlett, Vowels, & Saucier, 2008) and solely experimental research (Blond, 2008) have shown that muscular male figures in media are associated with (in surveys), or can lead to (in experimental research), body image concerns in men.

Notably, however, whilst the muscular male body type prevails in Western media, (Grogan, 2021), such body types often appear alongside other non-muscular male body types. Though, because the male muscular body type is desired by both men (e.g., Tiggemann, Martins & Kirkbride, 2007) and women (e.g., Dixson et al., 2014; Ridely et al., 2022), we would expect high muscle mass male media figures to capture the viewers' attention *more so* than males of other, less desirable body types. Indeed, men do show an attentional bias towards high muscle mass males when these are presented alongside thin and 'normal' bodies (Cho and Lee, 2013), average or obese bodies (Talbot et al., 2019); or alongside low muscle mass bodies or neutral stimuli (e.g., a car exterior) (Jin et al., 2019). Thus, even in the presence of 'distractor' bodies, it is the muscular male physique that captures one's attention and is therefore the body type that is most likely to prevail as an ideal and form the basis to one's perception of normality. This could maintain unrealistic body standards for men and women. Indeed, part of the empirical work presented in this thesis explores men and women's bias in visual attention towards high muscle mass males when these body types are presented alongside an equal number of low muscle mass males as distractors, measuring whether such a bias in attention can increase preferences for male muscularity.

The overemphasis and overrepresentation of idealised low BMI female bodies and muscular male bodies in Western media has resulted in women overestimating their weight (Groesz, Levine & Murnen, 2002; Waller, Hamilton, & Shaw, 1992) and men underestimating their weight (Agliata & Tantleff-Dunn, 2004; Barlett, Vowels, & Saucier, 2008). All in all, those who fail to meet the idealised body size/shape portrayed in Western media may feel dissatisfied with their own bodies and, for women, this could lead to increased anorexia and bulimia symptomatology (Hawkins et al., 2004), whilst for men, this could lead to muscle dysmorphia (Leit, Gray, & Pope, 2002), steroid use (Field et al., 2005), and/or depression (McCray, 2004).

1.3.2.3. Individual differences and the effects of Western media's portrayal of body ideals

Whilst the previously mentioned literature suggests media can influence one's body ideals, preferences and can subsequently lead to body image-related issues, not all men and women who view idealised media imagery experience this and therefore some individuals may be more susceptible than others. For example, women who internalise media's Western body ideals, that is to cognitively adopt them and aspire towards them (Thompson et al., 1999a), may be more at risk of becoming body dissatisfied than those who don't (Nouri, Hill & Orrell-Valente, 2011). As highlighted in a recent review by Lennon and Johnson (2021), internalisation of body ideals, appears to be the key to Western media's influence on male body image, with such internalisation mediating the relationship between media use and one's drive for muscularity (e.g., Daniel & Bridges, 2010; Davids, Watson, Gere, 2019; Cramblitt & Pritchard, 2013; Giles & Close, 2008). Furthermore, men exposed to images of muscular men experience an increase in negative self-evaluations but only in those who are already dissatisfied with their own bodies (Blond, 2008). Further, women with low self-esteem are more likely to compare themselves to idealised images (Jones & Buckingham, 2005) and, when asked to compare themselves to idealised images of bodies from media, they are more likely to report body dissatisfaction following image exposure than those women who are asked to fantasise about what it would be like to be the person in the media image and those in the control condition where no instructions are given (Tiggemann, Polivy & Hargreaves, 2009). In addition, men and women who are already dissatisfied with their bodies are more likely to attend to idealised thin bodies over larger bodies which subsequently results in these individuals experiencing a shift in their perception of a normal body in the direction of the image type they preferentially attended to (Stephen et al., 2018). The equivalent work on male muscularity preferences is limited in comparison, highlighting the need for more work into this area and, as such, this will be a focus of the later empirical components of this thesis. Specifically, empirical components will explore whether those who internalise societal appearance ideals, who feel increased pressures to achieve a muscular physique and/or possess a strong drive for muscularity are more likely to experience a shift in their preferences for muscularity after viewing images of either high or low muscle mass male bodies.

Whilst most of the work described above focuses on how exposure to idealised bodies, like those commonly depicted in Western media, can increase one's body image concerns, there also exists a body of research that focuses more so on the perceptual changes of bodies that may take place as a result of such idealised image viewing. Specifically, the next section of this thesis will summarise the research that explores experimental manipulation of body type perceptions specifically. Such experiments involve exposing participants to idealised images of bodies, simulating the media's portrayal of the thin female and muscular male body ideals, to examine whether such exposure leads to shifts in body type preferences and/or perceptions of normality. This body of work is somewhat limited given that it focuses primarily on the effects of exposing participants to bodies that differ in BMI, rather than bodies that differ in muscularity.

1.4. Manipulation of body type perceptions

1.4.1. Visual diet effects

An individual's visual diet refers to the types of images they regularly consume. When examining experimental manipulation of body fat preferences, Boothroyd, Tovée and Pollet (2012) describe a 'visual diet hypothesis' whereby changes in body type preferences are thought to be induced by visual exposure to certain body types. Authors found that exposure to small (large) bodies increased (decreased) one's preferences for thinness. They describe such shifts in preferences as being a cognitive by-product of mere exposure.

1.4.2. Body adaptation effects

Some authors (e.g., Boothroyd, Tovée & Pollet, 2012) have argued that visual diet effects are based, at least in part, on visual adaptation mechanisms. Indeed, many studies have sought to explore shifts in perceptions of certain body types via the visual adaptation effect. This describes the phenomenon whereby there is a brief, temporary change in visual sensitivity or perception when exposed to a particular image set, which results in lingering aftereffects that can bias our perception of subsequently encountered stimuli (Brooks et al., 2020b; Webster, 2011). Visual adaptation effects are thought to arise due to persistent exposure to stimulus attributes that can cause changes in the response properties of active neurons (Clifford & Rhodes, 2005). Such aftereffects have been observed in different characteristics of low-level stimuli such as movement, colour and tilt (Thompson & Burr, 2009). However, the literature now examines aftereffects associated with more complex stimuli in the context of higher-level perceptual judgements such as adaptation to faces (Webster and MacLeod, 2011). Research shows that facial adaptations can occur for eye spacing, facial identity and masculinity (Little, DeBruine, & Jones, 2005), as well as for race (European vs African), age (adult vs infant) and species (human vs monkey) (Little et al., 2008).

The research exploring body adaptation effects is more limited. The studies that do exist show exposure to bodies that have been digitally manipulated to appear thin (overweight) can lead to over-estimation (underestimation) of one's own body size (Bould et al., 2018; Brooks et al., 2016; Hummel et al., 2013). Such exposure can also distort one's perception of a 'normal' (Bould et al., 2018; Brooks et al, 2020a; Glauert et al., 2009; Stephen et al., 2018; Stephen et al., 2019; Sturman et al., 2017; Winkler & Rhodes, 2005) and ideal (Boothroyd, Tovée and Pollet, 2012; Glauert et al., 2009; Winkler and Rhodes, 2005) body such that this becomes thinner (larger) once they have been exposed to thin (large) bodies. Moreover, men and women who are exposed to obese male bodies subsequently judge such body types more positively, an effect which was mediated by obesity exposure increasing one's preference for the way these bodies looked (Robinson & Christiansen, 2014). Furthermore, men exposed to obese male bodies subsequently viewed such body types as healthier and perceived them to be of a more 'normal' weight (Robinson & Kirkham, 2014). It is thought that body size adaptation effects can be transferred across identities of body adaptation and test stimuli (though cf. Bould et al., 2020). Specifically, comparable adaptation effects are observed when women are shown test stimuli of their own body, and thin or fat adaptation stimuli that are either one's own body or unfamiliar bodies (Hummel et al., 2012). Brooks et al. (2016) reported similar findings in that exposing women to thinner images of one's self or thinner versions of others subsequently resulted in them perceiving themselves and others as larger. However, such effects were stronger when adaptation and testing stimuli were of the same body type (e.g., both images of one's self).

Thus far there have only been two laboratory-based aftereffects studies exploring whether exposure to bodies of varying muscle mass can subsequently distort one's perception of 'normal' levels of muscularity: Sturman et al. (2017) found that men (N=25) and women's (N=39) 'points of subjective normality' for a body changed following exposure to either i) increased fat, ii) decreased fat, iii) increased muscle, or iv) decreased muscle adaptation image conditions. Specifically, they found a shift in participant's points of subjective normality, following image exposure, in the direction of the adapting images along the relevant (fat or muscle) axis. Furthermore, Brooks et al. (2020a) analysed the responses of the 64 participants recruited for the Sturman et al. (2017) paper, alongside a newly recruited sample of participants (N=64: 39 males and 25 females). Analyses here revealed further evidence for musculature adaptation effects, but also revealed these adaptation effects were stronger when participants viewed body stimuli that matched their own gender, as opposed to 'other-gender' stimuli. Not only do these studies suggest that viewing high (low) muscle mass images can subsequently distort one's perception of 'normal' levels of muscularity, but they also suggest that the neural mechanisms involved in body fat and muscle perception are independent of one another and are encoded by dissociable neural mechanisms. This is important given that muscle mass and fat mass are both correlated (due to larger people having more fat and muscle) yet have very different associations with health.

As described in the previous section of this literature review, Western media is dominated by images of idealised bodies. Individuals with access to this media are therefore exposed to a constant stream of images depicting unrealistically thin female bodies and often unrealistically muscular male bodies. This type of exposure may be altering one's perception of subsequently seen bodies either via the visual adaptation effects described above, or via simple visual diet effects whereby one experiences a cognitive bias towards those body types they are more familiar with. As a consequence, unrealistically thin female bodies, and unrealistically muscular male bodies being perceived as the norm. This misrepresentation of what is perceived to be normal may then become internalised, and due to the persistent nature of media exposure, individuals may maintain this misrepresentation of what is normal. This could create and maintain unrealistic body standards for men and women and could also affect the types of bodies that men and women find attractive in the opposite sex.

1.4.3. Problems with the current body perception manipulation work

Aside from there being limited work into manipulating one's perceptions of muscularity, a more general issue is that much of this research has been carried out in artificial laboratory settings which raises questions as to whether body perceptions are just as malleable under more ecologically valid settings. Carbon and Ditye (2012) attempted to explore this, though they studied faces not bodies. Following the manipulation phase (carried out in a controlled, formal experimental laboratory setting, whereby participants were exposed to either compressed, original or extended versions of celebrity faces), some participants were instructed to complete the test phase (where participants had to select the veridical face from two versions) in a more ecologically valid setting of an informal leisure room, whilst others completed the test phase back in the formal laboratory setting. The authors reported participants' skewed perceptions of famous face veridically as a result of manipulation image viewing , can last up to one week, but crucially they also concluded that such effects are not simply lab-biased effects limited to highly artificial laboratory environments, but rather can be transferred to a test setting that is very different to, and more ecologically valid than, the manipulation setting.

It should be noted that to explore the impact of idealised body exposure in more ecologically valid contexts, there have been attempts to assess self-reported media use and its effect on body dissatisfaction and internalisation of idealised bodies more generally, with such studies described earlier in this chapter. Though, for such studies, it is often difficult to establish causal relationships and, given this issue, experiments that attempt to manipulate one's body preferences in more controlled settings may provide a more valid means to examine the impact of idealised image exposure. Given that the existing work exploring manipulation of musculature perceptions has required participants to complete manipulation trials in artificial laboratory settings (e.g., Sturman et al., 2017; Brooks et al., 2020a), the musculature body preference work described within parts of the empirical components of this thesis will, alternatively, and as recommended by Carbon and Ditye (2012), measure whether shifts in perceptions can still be observed when participants complete trials in less artificial settings where they perhaps feel more comfortable e.g., on a laptop at home. Indeed, this type of setting best replicates the context in which an individual is likely to consume Western media, and, notably, it is a central aim of this thesis to mimic such idealised media exposure in an attempt to examine whether this can shift one's male body type preferences.

A further issue with body perception manipulation work is that these studies often use manipulation condition designs that involve repeat exposure to images of just one body type (e.g., Brooks et al., 2016; Brooks et al., 2018; Glauert et al., 2009; Stephen et al., 2018; Winkler & Rhodes, 2005). It has been argued that stimulus presentation of this kind can lead to demand characteristics

(Want, 2014), that is participants discerning the intention of the study and consciously shaping their responses. As such, one of the recommendations for future work is to examine whether manipulation stimuli can still affect perceptions of bodies when manipulation conditions involve stimulus presentation that is less obviously skewed towards a particular body type. A stimulus presentation design of this kind would arguably more accurately represent the array of bodies present in Western media. Specifically, whilst the muscular male body type prevails in Western media (Grogan, 2021), such muscular body types are often presented alongside other body types. If research can demonstrate evidence of shifts in participants' musculature preferences, even when a proportion of the manipulation trials include 'distractor' images of a different body type, this would suggest Western media's portrayal of the muscular body ideal, even when it also depicts males of different body types, could still be affecting preferences for muscularity. As such, part of the empirical components of this thesis will explore whether musculature preferences can still be manipulated when manipulation images are less obviously skewed towards either high or low muscle mass male bodies.

Further, as previously noted, the existing work examining shifts in body perception focuses on how body type image exposure can distort one's estimation of their own body size (e.g., Bould et al., 2018; Brooks et al., 2016; Hummel et al., 2013) or one's perception of what a normal (e.g., Bould et al., 2018; Brooks et al, 2020a; Glauert et al., 2009; Stephen et al., 2018; Stephen et al., 2019; Sturman et al., 2017; Winkler & Rhodes, 2005) and ideal (Boothroyd Tovée and Pollet, 2012; Glauert et al., 2009; Winkler and Rhodes, 2005) body looks like. The existing *musculature* perception shift research, however, has *only* explored shifts in perceptions of *normal* muscle mass (Brooks et al., 2020a; Sturman et al., 2017) following manipulation image viewing and it is then assumed that this distorted perception of normality could affect one's body image. However, one could argue that just because one's perception of normality shifts in the direction of the manipulation image body type, does not necessarily mean that one's drive/desire to achieve such a body type shifts too. There therefore exists a gap in the literature in that existing work (Brooks et al., 2020a; Sturman et al., 2017) has not sought to explore whether idealised body exposure can lead to shifts in body type *preference*s specifically. It could be argued that one's body type preference, over their perceptions of what constitutes a normal body, is a better predictor of one's attitudinal and behavioural drives towards such idealised body types. This is because it is possible to think a high muscle mass male or ultra-thin female is ‘normal’, yet if one does not prefer these body types over others, they may not be motivated to achieve such a body and will thus not necessarily experience negative body image as a result of viewing such idealised imagery.

However, the research of Glauert et al. (2009) revealed that whilst there were large discrepancies between *some* of the women’s body norms and body ideals, following exposure to thin bodies, what these women considered to be normal *and* ideal *both* became thinner. Furthermore, Winkler and Rhodes (2005) found that the changes in men and women’s perceptions of normality following exposure to narrow or wide female bodies were accompanied with congruent shifts in which bodies were perceived to be attractive. They therefore concluded that, for female body stimuli at least, our perception of a normal female body shape may function as a reference point against which attractiveness of a body is judged and thus the two constructs may be linked. Therefore, perhaps this too is the case with musculature perceptual shifts of male bodies. Specifically, perhaps perceptions of normality and preferences can *both* become more muscular when exposed to high muscle mass male bodies. Whilst the empirical work described in the later sections of this thesis will not examine shifts in one’s perception of a normality, as has been the case with previous musculature perception work (e.g., Brooks et al., 2020a; Sturman et al, 2017), it will address a gap in the literature, examining muscularity preference shifts following manipulation image viewing specifically.

Finally, much of the current body perception manipulation literature fails to explore individual differences; Specifically, whether some individuals’ body perceptions are more malleable over others, despite being exposed to the same idealised images. The earlier sections of this chapter have already presented evidence that shows those who possess pre-existing body image concerns may be more prone to the negative impact of Western media viewing, including, for example, increased negative self-evaluations and heightened body dissatisfaction following media exposure. One explanation for this is that the magnitude of the body size after-effects are thought to be associated with body satisfaction, in that the such effects are is stronger for those who are already dissatisfied with their own bodies (Glauert et al., 2009; Stephen et al., 2018). This may be because those with low levels of body dissatisfaction are likely to pay more attention to idealised (muscular) same-sex (male) bodies (Cho & Lee, 2013) and this is thought to be especially common amongst those males who are at high risk of muscle dysmorphia, for example (Jin et al., 2018). Indeed, a recent systematic review and meta-analysis by House et al. (2023) found some evidence from eye tracking studies for a positive association between body dissatisfaction and attentional bias towards low weight female bodies amongst women. Recent research has explored the relationship between body satisfaction and the direction and magnitude of the body fat adaptation effect mediated by visual attention to idealised bodies (Stephen et al., 2018). Findings indicate that both men and women who are dissatisfied with their own bodies, direct a higher number and duration of fixations to thin bodies. They also show a shift in their point of subjective normality following the manipulation phase, perceiving thinner bodies as more normal compared to their perceptions of normality pre- manipulation phase. Sturman et al. (2017) and Brooks et al., (2020a) both found that exposure to muscular bodies does result in a shift in the point of subjective normality towards more muscular looking male bodies, however, unlike the equivalent work on thin bodies, they did not seek to demonstrate whether it was those who were most dissatisfied with their bodies who were more susceptible to this effect, nor did they test whether this effect was mediated by visual attention. The empirical component of this thesis therefore seeks to explore visual attention, body satisfaction (including one's drive for muscularity, internalisation of cultural body ideals, and perceived pressures to achieve such ideals), and manipulation of musculature preferences in an attempt to work towards filling this gap in the literature.

Whilst the empirical work presented in this thesis does not examine musculature preference shifts in the context of visual adaptation effects, it does, much like the aforementioned body adaptation literature, seek to explore the effects of high (or low) muscle mass exposure, and how this visual diet may, via visual diet effects, affect one's later preferences for muscularity.

1.5. Musculature preferences and body image in childhood and adolescence.

1.5.1. Why explore muscularity preferences in childhood and adolescence

Much like the minimal literature exploring musculature preferences and male body image in adult participants, comparable research with children and adolescent groups is also a neglected field of study. Most of the existing developmental work focuses exclusively on girl's body image in the BMI/body size dimension and/or their preferences for thinness. This section will therefore briefly summarise the work on girls, before then highlighting the limited current research on boys' body image in the muscularity dimension and preferences for muscularity which forms the basis to the empirical work described in Chapter 4 of this thesis.

1.5.2. What is adolescence?

Most researchers have defined adolescence as a period of development that starts at puberty and ends at 18 which is the legal age of adulthood in most Western countries. More recently, researchers have proposed that the age range of 10-24 years old may be a more appropriate reflection of the adolescence period given that this reflects the fact that boys and girls are now experiencing puberty earlier than has been historically normal, whilst also increasing the endpoint of adolescence to reflect our current understanding of continued growth (Sawyer et al., 2018). Whilst researchers may not necessarily agree on the exact timeframe of adolescence, they accept that adolescence represents the transition from childhood to adulthood where one experiences important physical, emotional and cognitive changes. Most developmental work has divided adolescence into an early phase (approximately 11 to 14 years) and a later phase (approximately 15 to 18 years) (Christian et al., 2020; Dally, 1977; Matthiessen et al, 2008; Smithers et al, 2000), with Christian et al. (2020) proposing that these age categories represent unique developmental stages in terms of one's physiological and neurological development, maturity and autonomy. Specifically, the early phase of adolescence is marked by the onset of puberty and more mature relationships with peers, whilst the later phase of adolescence is centred around achieving an identity and integrating sexuality into relationships (Cobb, 2010).

1.5.3. Current developmental work on girls

The literature exploring female body image in the BMI dimension shows girls as young as six desire thin ideal bodies, with peer and media influences being significant predictors of body image and dieting awareness at this age (Dohnt & Tiggemann, 2006a), girls as young as twelve admitting to restricting their food intake and expressing guilt about their eating (Wardle & Beales, 1986) and girls as young as eight comparing their own bodies to their peers' bodies and those idealised bodies portrayed in the media (Tatangelo & Ricciardelli, 2017). It seems, however, that as girls progress through adolescence, their body image disturbance becomes more pronounced (Bucchianeri et al., 2013) perhaps because during this time girls experience an increase in the amount of fat around the hips and thighs as indicated by objective MRI measurements (De Ridder et al., 1992). Indeed, Bucchianeri et al. (2013) found increased body dissatisfaction throughout adolescence (12-24 years old) was a trend associated with similar increases in BMI over time. It is during adolescence when girls are most likely to start exercising excessively, restrict eating and develop eating disorders, with the age at onset being around 18 years old for both anorexia nervosa and bulimia nervosa groups. Though, it should be noted that the distribution for anorexia nervosa is bimodal, with peak early onset at 16.7 years-old and peak late onset at 25.3 years-old (Volpe et al., 2016). It is the physical changes during puberty, together with increased peer influence and increased opportunities to engage in both maladaptive and adaptive decision-making processes that could make an adolescent girl become dissatisfied with her body weight, potentially leading to behaviours aimed at reducing weight (Casey, Jones & Hare, 2008). Lewinsohn, Striegel-Moore, and Seeley (2000) suggest that whilst diagnoses of anorexia nervosa peak during late puberty, the slopes towards being diagnosed actually begins increasing around the age of 10 years old but the behavioural disturbances may not become apparent until later on in life.

1.5.4. Developmental work on boys

When it comes to the literature related to boys and their idealised body shape, the current cultural ideal for males is the mesomorphic body shape (McCabe, & Ricciardelli, 2003). Whilst girls are more concerned about the size of their waist, boys are more concerned with their biceps, chest, shoulders and general muscle mass (McCabe & Ricciardelli, 2003; Ricciardelli, McCabe & Ridge, 2006). The literature exploring when this desire for muscularity first comes about is a vastly understudied area of research. Staffieri (1967) studied male children (aged 6-10) and asked them to assign adjectives associated with various behavioural and personality traits to silhouettes representing extreme body types. The young children assigned unfavourable adjectives to the ectomorph and endomorphs but assigned favourable adjectives to the mesomorph silhouettes, with Lerner and Korn (1972) presenting similar findings in males as young as five. Furthermore, the young boys showed a clear preference to look like the mesomorph image as well as demonstrating reasonable accuracy in their perception of their own body type, with their ponderal index and teacher judgements placing them into an ectomorph, endomorph or mesomorph category, which was a significant predictor ($p<.05$) of the figure they chose as being most similar to their own body. Similar findings have been reported in more recent publications, with McLean, Wertheim and Paxton (2018) reporting males as young as six may be experiencing the drive/desire for muscularity (at least the attitudinal component if not the behavioural component) and puberty in males predicting the use of food supplements and strategies to increase muscle tone in those aged 12-16 years old (McCabe, Ricciardelli, & Banfield, 2001).

As previously discussed, girls experience increased body image disturbance as they progress through childhood and adolescence (Volpe et al., 2016). There has, however, been limited comparable work that explores whether the same trend exists in boys. Though, a meta-analysis of 241 studies showed that the incidence of muscle dysmorphia in boys, peaks during adolescence, with the average age of onset at 18.67 years old (Tod, Edwards, & Cranswick, 2016). This mirrors the average age of 18 for the onset of anorexia nervosa and bulimia nervosa amongst samples made up of mainly girls (Volpe et al., 2016). Whilst boys may experience increased body image disturbance as they move through adolescence, there exists an alternative view worth considering; that as boys progress through adolescence, most will be capable of moving closer to achieving the idealised muscular body shape and therefore puberty can be a positive experience for some boys in relation to their body satisfaction. Specifically, pubertal development is a time at which boys will experience a surge in testosterone which increases shoulder width and allows them to start building up muscle more easily. With this in mind, we may expect body image disturbances to decrease with age in some boys and, indeed, Klump's (2013) review lends some support to this view, though authors note such work is limited and inconsistent. Given the minimal existing research, one of the aims of this thesis is to build upon the current limited pool of literature. Specifically, part of the empirical components will investigate the relationship between age, drive for muscularity, internalisation of cultural body ideals, perceived pressures to achieve such ideals and preferences for muscularity in 11–18-year-olds.

1.5.5. The effects of idealised bodies in media on children and adolescent groups

The empirical evidence to suggest that media, portraying unrealistic, overly muscular images of men, as having a negative effect on male body satisfaction has already been widely discussed in this thesis in the context of mostly adult male samples. However, it is also important to consider the extent to which such media can affect younger children, especially given the potential relationship between age and body image disturbance in young boys. Children may not necessarily be exposed to the same media content as adolescent and adult male populations, however, this does not mean they are immune to its effects, with sport magazine consumption increasing personal mesomorphic standards in pre-adolescent boys as young as 10 (Rousseau, Aubrey & Eggermont, 2020) and playing appearance-focused internet games increasing body dissatisfaction in girls as young as eight (Slater et al., 2017). Moreover, Dittmar, Halliwell and Ive (2006) found that 5-8-year-old girls exposed to images of Barbie dolls subsequently reported lower body esteem and a greater desire for a thinner body shape themselves than the girls exposed to images of larger dolls or those exposed to no dolls (the control condition). Interestingly, this negative impact of Barbie doll exposure was stronger for the younger girls of the sample. More recent work from Boothroyd, Tovée and Evans (2021) has similarly revealed that 5-9-year-old girls who played with ultra-thin dolls, including Barbie, subsequently experienced an increase in body dissatisfaction and their ideal body size was reduced. Unlike Dittmar, Halliwell and Ive (2006), however, Boothroyd and colleagues did not find this to be stronger in the younger participants.

Much like the female thin body ideal, the largely unattainable, muscular male body ideal is also prevalent in child accessible media, including, for example, in toy action figures. Pope et al. (1999) found such action figures have grown much more muscular in body size since the 1970’s with many exceeding the muscularity of even the largest human bodybuilders. More recent evidence from Boyd and Murnen (2017) lends further support to this; they reported that 42.3% of action figures sampled had noticeably muscular bodies, with Barlett et al. (2005) reporting that handling such toys can reduce body esteem in young men. Furthermore, Martins et al. (2011) found characters in the top 100 video games were also disproportionately more muscular than the average American male, with such idealized male characters more likely to be found in games targeted at children than in games for adults. Whilst there exists research exploring the effects of idealised image exposure on body preferences in adult men, the equivalent research on young boys and adolescent groups has been a vastly neglected field. As such, one of the empirical components of this thesis investigates manipulation of musculature preferences in 11-18-year-olds, exploring whether age can predict susceptibility to any visual diet effects.

1.5.6. Measuring body image disturbance in young people

There is debate with regards to how body image disturbance should be measured in young children with much of the research making use of body image instruments that closely resemble those used in the adolescent and adult body image literature. Ricciardelli and McCabe’s (2001b) review reveals that the psychometric data for these instruments is actually very good, and evidence suggests that they can be used reliably and validly with children. Furthermore, sociocultural pressures, self-concept and various other variables related to adult and adolescent body image have also been found to be associated with children's body image concerns and early eating disturbance, which makes comparisons between the groups easier and further supports the idea that using similar instruments to assess body image amongst young children is justifiable.

Part of the empirical work presented in this thesis will explore the relationship between age and i) drive for muscularity, ii) internalisation of cultural body ideals, iii) perceived pressure to achieve such ideals and iv) preferences for muscularity in young boys and girls. Furthermore, the empirical work will also explore whether viewing images of muscular male bodies will subsequently increase preferences for muscularity in different age groups, and whether age and/or i) drive for muscularity, ii) internalisation of cultural body ideals, and/or iii) perceived pressure to achieve such ideals, can increase susceptibility to such visual diet effects. These findings will have implications in that they will provide a clearer understanding as to when issues with male body image are likely to first arise and perhaps peak. If musculature preference manipulation is found to occur early on during childhood, this will further highlight the importance of being mindful of the types of media we are allowing young children to consume, a task that is becoming increasingly more difficult due to how easily accessible such idealised media imagery now is to young children.

1.7. The present thesis- Proposed empirical work and aims:

As highlighted in this literature review, studies examining the muscular male body ideal are limited and thus this research area is ripe for investigation. This thesis therefore seeks to explore preferences for male muscularity amongst men, women, boys and girls, examining whether such preferences are malleable and can shift in response to one's visual diet. The findings of such empirical work will have important implications as they will allow us to determine whether Western media exposure is likely to perpetuate, maintain, and/or intensify unrealistic standards of the male body, which could be contributing to body image disturbance in males. Details of each of the nine studies that make up the four empirical chapters of this thesis are summarised below.

Study 1 and Study 2 (Chapter 2) seek to explore whether 'visual diet' and/or 'associative learning' mechanisms best explain any changes in male musculature preferences following exposure to male bodies of high and/or low muscle mass that are aspirational (high status clothing and posture) and/or neutral (no obvious cues to status). Under the visual diet hypothesis, exposure to muscular (non-muscular) male bodies should cause a shift in preference towards muscular (non-muscular) male bodies irrespective of whether or not that image is of a positive or neutral valence. However, under the associative learning hypothesis, only those muscular (non-muscular) male bodies of a positive valence will shift preferences towards a more muscular (non-muscular) male body type. If the evidence points towards a visual diet mechanism, this would imply that media's overemphasis of muscular male bodies can shape our male body type preferences. However, if the evidence points towards associative learning mechanisms, this would imply that changes in the preferences for muscularity amongst males and females are more complex and may be best explained by the internalisation of positive associations attributed to muscularity in the West (e.g. health and high-status) and this could be due to the way in which media portrays high muscle mass males. Studies 1 and 2 additionally seek to explore whether one's drive for muscularity can predict changes in preferences for muscularity following the viewing of manipulation images. Such work is crucial as it will allow us to further ascertain whether Western media's promotion of high status, high muscle mass male bodies is likely to be increasing personal preferences for male muscularity in both men and women. It will also allow us to explore whether any groups (e.g., men who possess a strong drive for muscularity) are particularly susceptible to image exposure shifting their preferences.

Study 3 (Chapter 2) seeks to build upon Studies 1 and 2, examining whether musculature preferences can still be manipulated when manipulation conditions are less obviously skewed towards images of a particular body type. This is an important area of research given that most studies attempting to manipulate perceptions of bodies present manipulation images in a way that could result in demand characteristics, that is, participants discerning the intention of the study and consciously shaping their responses. Study 3 will therefore include 'distractor images' presented alongside the idealised manipulation images of bodies to lessen the potential influence of demand characteristics, allowing us to explore whether musculature preference changes can be observed even when manipulation image bias towards either high or low muscle mass male bodies is more subtle.

Study 4 (Chapter 3) also seeks to explore changes in male musculature preferences whilst also investigating whether males who show strong internalisation of cultural body ideals and/or pressures to achieve such ideals are more susceptible to such changes following image viewing. Such findings are crucial as they could help us to identify those who are potentially more vulnerable to the negative effects of viewing Western media body ideals, allowing future work to target intervention at these groups.

Chapter 4 presents a collection of studies that seek to explore body concerns, attitudes towards, and preferences for, muscularity across childhood and adolescence. **Study 5** seeks to examine the age profiles of internalisation of cultural body ideals, perceived pressures to achieve such ideals, and drive for muscularity amongst 11-18-year-old boys and girls. **Study 6** will explore the age profiles of boys' and girls' muscularity male body preferences, as well as whether manipulation of male musculature preferences can be observed in 6-18-year-old boys and girls. Study 6 will also examine whether age, internalisation of cultural body ideals and/or pressures to achieve such ideals can predict the extent to which such manipulation image viewing can skew body type preferences. **Study 7** will examine 11-18-year-olds perceptions of high and low muscle mass media figures by asking them to provide free-text responses. The findings of Studies 5, 6 and 7 will allow us to better understand when issues with male body image are first likely to arise. Findings will enhance our knowledge of the understudied research area of body image in young children and adolescents. In particular, it will build upon the limited developmental literature that focuses on the muscular body ideal specifically, and children's preferences for, and perceptions of, high and low muscle mass male bodies. Findings from these three studies will allow body image interventions to be best targeted towards particular groups (e.g., certain age groups) that may be more vulnerable to the negative effects of media exposure, thus helping to prevent the development, maintenance, or intensification of preferences for unrealistic, largely unattainable muscular physiques and unrealistic body standards in young people.

Chapter 5 will investigate, using the dot probe paradigm (**Study 8**) and eye tracking (**Study 9**), whether men and women show a bias in visual attention towards high muscle mass male bodies (when presented with both high and low muscle mass male bodies at the same time) and whether one's drive for muscularity, internalisation of cultural body ideals and/or perceived pressures to achieve such ideals can predict any bias in attention towards such images which could then lead to stronger male musculature preference changes in these individuals. This, again, represents a vastly neglected field of work, with most body attentional bias studies focusing on female bodies and/or the thin ideal specifically. Studies 8 and 9 build upon the limited existing work on attentional bias towards high muscle mass male bodies by additionally exploring whether attentional bias here can affect perceptions of subsequently viewed bodies such that our preference becomes skewed towards the body type that we preferentially attend to. This work will be the first of its kind to explore this.

1.8. Methodological Considerations

Methodological considerations are described within each empirical chapter of this thesis; however, below is an overview of the main measures used as part of the empirical work. Considering the previously mentioned literature that suggests men are less likely to open up about body image concerns in front of peers (e.g., Adams, Turner & Bucks, 2005: Diedrichs, Lee & Kelly, 2011; Hargreaves & Tiggemann, 2006), likely because this is often perceived as a sensitive or embarrassing topic area for many men, all measures described below were collected via online anonymous questionnaires. The intention of collecting sensitive information in this way was to reduce any response bias or non-participation.

1.8.1. The Drive for Muscularity in males (DMS; McCreary & Sasse, 2007)

The Drive for Muscularity Scale (DMS) (Mcreary & Sasse, 2000) is a 15-item psychometric scale which describes a man's desire and motivation to be more muscular when it comes to body image. Every item is scored on a Likert-type scale from 1 (Always) to 6 (Never). It is comprised of two subscales: an attitudinal muscularity-oriented body image subscale e.g. 'I wish that I were more muscular' and a muscularity behaviour subscale e.g., 'I lift weights to build up muscle'. The DMS is widely used in studies assessing male body dissatisfaction, whereby respondents are asked to what extent they agree with certain statements regarding preoccupation with building muscle. McCreary and Sasse (2000) found that males who score high on the DMS were more likely to be trying to gain both weight and muscle mass.

The scale was found to be one of the most effective measures of male body image following a review of methodology (Cafri & Thompson, 2004), is associated with negative emotions and behaviours, including low self-esteem (McCreary and Sasse, 2000: Nowell & Ricciardelli, 2008), and is associated with the use of performance enhancing substances (Dodge et al., 2008) and excessive weight-lifting behaviours (Litt & Dodge, 2008). Those who score highly on the DMS scale are likely to be suffering from muscle dysmorphia, a form of body dysmorphia in which an individual becomes pathologically preoccupied with their degree of muscularity (Pope et al., 1997).

1.8.2. The Sociocultural Attitudes Towards Appearance Questionnaire – 4 (SATAQ-4; Schaefer et al., 2015)

The SATAQ-4 is a measure of two distinct, but often related, constructs: internalisation of cultural body ideals and the pressure one feels to achieve such ideals. The SATAQ-4 contains 22 items split into five subscales concerning internalisation of the thin/ low body fat ideal (e.g. "I want my body to look very thin"), internalisation of the muscular/athletic ideal (e.g. "I think a lot about looking muscular"), pressure from family (e.g. "Family members encourage me to get in better shape"), pressure from peers (e.g. "My peers encourage me to get thinner"), and pressure from the media (e.g. "I feel pressure from the media to improve my appearance") to obtain and maintain an idealised body. Items are forward scored on a 5-point Likert-style scale from 'definitely disagree' to 'definitely agree' where a high average score indicates more perceived pressure to be thin/muscular. This questionnaire has been shown to have good reliability and validity (Barra et al., 2019; Schaefer et al., 2015).

1.8.3. Why measure DMS and SATAQ-4 scores?

One reason for collecting participants' SATAQ-4 and DMS responses was so that scores could determine whether both or either of these measures could affect one's susceptibility to visual diet effects following manipulation image viewing. As previously noted, the existing research exploring changes in body size preferences following image viewing has mainly focused on body dissatisfaction as a potential predictor of any body size preference changes. Stephen et al. (2018), for example, used a single-item measure of body satisfaction in their study examining manipulation of perceived body fat normality, arguing that single-item measures of this kind are highly correlated with a range of validated body satisfaction inventories. Given the complexity of body image disturbance and the nuanced factors that could be contributing to this, for the work presented in the empirical chapters of this thesis, it was decided that using multi-item questionnaires, like the SATAQ-4 and DMS, would better capture which, if any, specific factors linked to one's body image disturbance could predict susceptibility to visual diet effects.

1.8.4. Stimuli

A key methodological consideration for the proposed empirical work of this thesis is the type of stimuli chosen for trials. Because there are strengths and drawbacks of using both Computer Generated Images (CGI) and photograph stimuli, some of the studies presented in the empirical components of this thesis used solely CGI stimuli for manipulation image trials, whilst others used solely photographs, and others a mixture of the two. Details of which stimuli were chosen for each study are described within each of the empirical chapters. CGI images allowed us to use a 'base male' body of which *just* the muscularity of the body could be manipulated, meaning that such stimuli were well-controlled. The downside of using CGI bodies as stimuli, however, is that such images do not represent the variety of idealised muscular male bodies depicted in Western media. Specifically, whilst many of these idealised male media figures may share the muscular physique, they will also possess other features that likely differ from one another e.g., facial features, skin tone, height etc. Thus, to truly represent the array of different muscular male bodies depicted in Western media, and to be more ecologically valid in attempts to mimic this, some manipulation image trials should seek to present photographs of real male bodies pre-rated for muscularity either on their own or presented alongside CGI images.

All CGI images were created on DAZ Studio 4.10, using the 'Genesis 2 Base Male' in basic white briefs. These images differed only on 'Bodybuilder', 'Bodybuilder Details', 'Bodybuilder size' and 'Emaciated' slider scores. Twelve high and twelve low muscle mass CGI bodies were created in total. The high muscle mass images had the built in 'Bodybuilder', 'Bodybuilder Details' and 'Bodybuilder size' slider settings randomly set to either medium or high (50-100 slider value) and the 'Emaciated' slider score remained at baseline level (0 slider value). The low muscle mass images had 'Bodybuilder', 'Bodybuilder Details' and 'Bodybuilder size' slider settings set to low (0-25 slider value) and the 'Emaciated' slider setting set to either medium or high (50-100 slider value). In terms of photograph stimuli, there were two sets of photographs used in the studies examining manipulation of musculature preferences. The first were a set of 48 open-access images retrieved from Morrison et al. (2017) of which 24 had been pre-rated as high muscle mass, and 24 as low muscle mass. These bodies were in the standard anatomical position (standing with arms out to the side, legs apart and facing the camera straight on) with faces and genitals obscured. The other set of photographs used were a set of 50 high and 50 low muscle mass male media figures from various male clothing websites (e.g., Father Sons Clothing and Fred Perry) The men in these images were in high status clothing and in high status postures. Stimuli had been pre-rated for muscularity and grouped accordingly. The details of the muscularity pre-rating task for stimuli is described within the empirical chapters of this thesis.

Chapter 2.

Experimental manipulation of muscularity preferences through visual diet and associative learning

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This chapter includes details of my published work which is made up of three related musculature preference manipulation experiments, Studies 1, 2 and 3. All three studies examined changes in muscularity preferences following the viewing of images of male bodies of high and/or low muscle mass. Studies 1 and 2 explored whether 'visual diet' or 'associative learning' mechanisms could best explain any changes in muscularity preferences and examined whether one's drive for muscularity could predict susceptibility to any such visual diet effects. Study 3 explored whether changes in musculature preferences were evident when manipulation conditions were less obviously skewed towards a particular body type. Studies 1, 2 and 3 are presented in their published form but are formatted to align with the overall formatting requirements of this thesis.

2.1. Abstract

Body preferences are somewhat flexible and this variability may be the result of one's visual diet (whereby mere exposure to certain bodies shifts preferences), associative learning mechanisms (whereby cues to health and status within the population are internalised and affect body preferences), or a mixture of both visual diet and associative learning effects. We tested how these factors may drive changes in preferences for muscularity in male bodies across a male and female sample. Three studies were conducted where participants viewed manipulation images of high and/or low muscle mass males which were either aspirational (high status clothing and posture) and/or neutral (no obvious cues to status). Preferences for muscularity were recorded before and after exposure to such manipulation images to assess whether body preferences had changed following manipulation. We found evidence for both the visual diet and associative learning hypotheses. Exposure to non-muscular male bodies decreased preferences for muscular bodies irrespective of image valence. Exposure to aspirational non-muscular male bodies alongside neutral muscular male bodies also led to

a decrease in muscularity preferences. Further, when manipulation conditions are less obviously skewed towards a particular body type, preferences still shifted in the direction of the most prevalent body type, suggesting that demand characteristics are unlikely to have confounded results of previous adaptation experiments with more obvious manipulations.

2.2. Introduction

Body ideals or body preferences–that is the tendency for people to consider particular sizes and shapes of human bodies to be more attractive, appealing or desirable than others–are important in many respects. Body weight can affect an individual's chances of social success (Nickson et al., 2016), can be an important contributor to perceived attractiveness (Tovée et al., 1997), and is a critical component in body image and thus a key facet of self-esteem (Tiggemann, 2005). The bulk of research on body ideals has concentrated on weight or body mass index (BMI; weight in kg /height in m2) in women, and has therefore neglected muscularity as an important body ideal in men. The current paper seeks to test mechanisms of variation in observers' preferences for muscularity in male bodies.

2.2.1. Drivers of variation in preferences

The extensive variability in body size and shape preferences is particularly evident from cross cultural work, although it largely concentrates on female BMI as noted. Research participants in Western, industrialised cultures, with a reliable food supply, for example, prefer thinner female figures, while some non-Western populations, with unreliable food supplies, prefer larger female bodies (e.g., Anderson et al., 1992; Tovée et al., 2006). Variability also exists within ethnic groups; for instance, urban Thai participants associate high BMI with low health and fertility, while the converse is true in rural Thailand, resulting in different body size preferences (Swami & Tovée, 2007). A similar association between body preferences and socio-economic development was documented in Malaysia (Swami & Tovée, 2005a).

In the Western world (meaning predominantly Europe, and other White-majority countries), thinner women are mostly viewed in a positive light, with people more willing to engage in social, academic and recreational activities with these individuals (Greenleaf et al., 2006) whilst overweight female figures are often stigmatised (Swami et al., 2010). Higher body mass (indexed by obesity) is increasingly associated with lower SES within countries (e.g., Hispanic and white youth US samples; Fradkin et al., 2015). This, together with the fact that malnourishment is extremely rare in the West, suggests that amongst Westernized samples low BMI female bodies are associated with perceptions of better health, higher prestige and higher SES, whilst high BMI female bodies often have negative associations. Researchers propose that the thin ideal is starting to become widely international in nature and that this, at least in part, can be explained as a function of globalisation of Western media (Swami et al., 2010). This may also explain why body preferences appear to move towards Western body ideals when, for example, black South Africans migrate to Britain (Tovée et al., 2006); they begin to adopt the thin ideal that is so prevalent in the UK. Similarly, evidence suggests non-Western individuals who consume Western media show changes in body size preferences towards lower BMI for females (Boothroyd et al., 2016; Jucker et al., 2017; Swami et al., 2010) and experimentally viewing idealised bodies increases preferences for low BMI female bodies in laboratory studies (Boothroyd, Tovée & Pollet, 2012; Challinor et al., 2017; Glauert et al., 2009; Winkler & Rhodes, 2005).

Boothroyd, Tovée and Pollet (2012) argued that there are two potential routes through which globalisation of media may influence preferences. Firstly, individuals and larger groups may vary in ‘visual diet’, with high (or low) levels of exposure to a particular category of stimulus (in this instance very slim women in media) inducing changes in preferences through visual adaptation effects altering the individuals’ perceptions of a ‘normal’ example of that stimulus. Secondly, given the associations with body weight discussed above, ‘simple’ associative learning mechanisms may also play a role. They therefore sought to explore the underlying internal mechanisms underpinning changes in preferences for BMI in female bodies using visual adaptation procedures and manipulation images that varied in BMI and valence. They found evidence for the visual diet hypothesis, with exposure to thin or large bodies shifting participants’ body weight preferences in the predicted direction, regardless of whether or not bodies were aspirational or non-aspirational. The authors also carried out a further study as part of the same paper which induced associative learning whilst making a visual diet effect impossible (equal numbers of large and thin images of varying valence). Exposure to overweight, aspirational women, together with equal exposure to low BMI, non-aspirational women, resulted in a shift in body weight preferences towards larger bodies. Overall findings thus suggested both visual diet and associative learning influences may act, to an extent, in parallel. However, consistent with the previous body preference literature, this study did not examine changes in preferences for muscularity in male bodies.

2.2.2. Preferences for male muscularity

As already noted, female bodies have been used as stimuli in the vast majority of research on variation in body size ideals. Preferences for male muscularity and variability in such preferences has been an understudied area but is worthy of consideration. The limited existing male body literature suggests that preferences for muscularity in males may, much like preferences for BMI in females, be variable across cultures. For example, when asked to rate individual photographs of men whose bodies varied in waist-to-chest-ratio (WCR), body-mass-index (BMI) and waist-to-hip ratio (WHR), men in urban settings in both Britain and Kuala Lumpur preferred slim male bodies with the muscular 'inverted triangle', over those bodies with higher body mass and thus a less pronounced upper body shape. This suggests WCR as the primary component of attractiveness for these individuals. Conversely, in the rural region of Kota Belud, in Sabah, one of East Malaysia's least economically developed states, men preferred heavier bodies with a less triangular shape and BMI was statistically the primary predictor of male body attractiveness (Swami & Tovée, 2005b).

Media also often over-represents idealised, muscular male bodies (Law & Labre, 2002; Leit, Pope & Gray, 2001) just as they do slim female bodies. It is therefore likely that frequent exposure could shift perceptions of normality and preferences towards male muscularity. To date, one study has observed experimental visual adaptation to muscularity in the laboratory (Sturman et al, 2017).

Furthermore, muscularity may also, like slimness, be associated with health and high status in the Western culture. For instance, favourable stereotypes of muscular male bodies have been observed, with participants describing them as physically healthy, clean and attractive. In contrast, they possess negative stereotypes of non-muscular endomorphs, describing them as physically unhealthy, dirty and unattractive) (Ryckman et al., 1989). Western figures in media are often of high SES and are associated with positive attributes, for example, muscular figures in top-grossing films between the years of 1980–2006 were more likely to be central characters who were romantically involved with others, and who experienced more sexual activity and more positive outcomes in such films (Morrison & Halton, 2009).

Because muscular male figures now dominate much of Western media (Law & Labre, 2002; Leit, Pope & Gray, 2001), are frequently positively valanced (Leit, Pope & Gray, 2001), and are frequently digitally manipulated to further enhance muscular bodily features (Reaves et al., 2004), it is likely such media exposure is affecting our body preferences for male bodies, just as such media exposure increases preferences for idealised body types (Boothroyd, Tovée & Pollet, 2012) and affects 'perception of normality' (e.g., Glauert et al., 2009; Stephen et al., 2018) in female bodies. Indeed, it is critical to focus more research on this understudied area of male muscularity preferences, investigating whether viewing idealised male media imagery can affect conceptions of what such males subsequently view as 'ideal' or 'normal' standards for their own bodies. Further, exploring potential mechanisms underpinning changes in these preferences is crucial if we are to work towards developing successful strategies aimed at improving male body image in the West.

2.2.3. Current study

The current research aimed to build upon the methods of Boothroyd, Tovée and Pollet (2012) to investigate whether shifts in preferences for muscularity are the result of our 'visual diet' (the idea mere exposure to certain body shapes can shift our preferences); due to 'associative learning' mechanisms (the idea that muscularity is associated with positive attributes of health and status in the west), or a mixture of both. This paper explores changes in preferences for muscularity in male bodies across both male and female observers. We include female participants in our sample as both men and women are exposed to media messaging related to what is attractive/ normative/ high status in a male body, so we would argue that it is reasonable to expect that both men and women's preferences should be affected by increased exposure to males of a particular body type and valence. Indeed, previous work on adaptation to muscularity by Sturman et al. (2017), found effects for both men and women viewing both male and female stimuli. That study, however, used neutral stimuli (e.g., images of males in standardised tight fitting grey singlets and shorts, posed in a standardised anatomical position) and thus failed to explore whether susceptibility to visual adaptation is more likely when stimuli used are of a positive valence (e.g., males in high status clothing, with high status posture of differing muscle mass), something that the current study seeks to address. In Study 1, manipulation conditions involved participants viewing either aspirational, high muscle mass male bodies (condition 1), aspirational, low muscle mass bodies (condition 2), neutral, high muscle mass bodies (condition 3) or neutral, low muscle mass bodies (condition 4).

We predicted that under the visual diet hypothesis, exposure to muscular (non-muscular) male bodies would cause a shift in preference towards muscular (non-muscular) male bodies irrespective of whether or not that image was of a positive or neutral valence. However, under the associative learning hypothesis, we predicted that only those muscular (non-muscular) male bodies of a positive valence would shift preferences towards a more muscular (non-muscular) male body type. If the evidence pointed towards a visual diet mechanism, this would imply that media's overemphasis of muscular male bodies has potentially shifted body preferences and perhaps our perceptions of a normal male body. However, if the evidence pointed towards associative learning mechanisms, this would imply that changes in the preferences for muscularity amongst males and females may be explained by the internalisation of positive associations attributed to muscularity in the West (e.g., health and high-status) and this could be due to the way in which media portrays high muscle mass males. Based on the work of Sturman et al. (2017), we hypothesise that the viewing of high (low) muscle mass images may increase (decrease) preferences for muscularity and this change will potentially be stronger when images are of a positive valence.

We ran two further manipulation conditions (Study 2), to explore whether associative learning effects could be observed in a situation in which visual diet effects would be impossible to observe. Study 2 involved participants viewing either a combination of aspirational high muscle mass male bodies together with neutral low muscle mass male bodies (condition 5), or, viewing a combination of aspirational low muscle mass male bodies together with neutral high muscle mass bodies (condition 6). Specifically, this allowed us to test the hypothesis that preferences for muscularity are likely to shift in the direction of the high valence image type, whether it be high or low muscle mass.

A key consideration in studies using repeated exposure to similar stimuli is that of demand characteristics i.e., participants discerning the intention of the study and consciously shaping their responses in line with this. In line with the recommendations of Want (2015), we include a study that made use of ‘distractor images’ presented alongside the idealised manipulation images of bodies to lessen the likelihood of demand characteristics acting as a confound and to test whether adaptation still occurs when manipulation image bias towards a particular body type is more subtle. In Study 3, therefore, participants viewed manipulation images that consisted of 69% high muscle mass images versus 31% low muscle mass images or vice versa. We then measured whether there was a change in preference for muscularity under each of these manipulation conditions. If the adaptation effect holds, we predict that preferences for muscularity will still change in the direction of the most prevalent image type viewed (high or low muscle mass).

Pre-existing body concerns, in both Studies 1 & 2, was measured using the Drive for Muscularity Scale (DMS) (McCreary, 2007). Evidence from research with women suggests pre-existing concerns such as body dissatisfaction may moderate how susceptible one is to visual adaptation effects, with most research (with the exception of Boothroyd, Tovée & Pollet, 2012) finding that individuals who are dissatisfied with their bodies are more susceptible to visual adaptation effects in the body size dimension (Glauert et al., 2009; Stephen et al, 2018). As an exploratory part of our research, we sought to examine whether the same may be true of males in our sample when assessing susceptibility to the visual adaptation effect in the muscularity dimension. Specifically, we hypothesise that those who are most concerned about the muscularity of their bodies (as measured by DMS) are those who will show stronger shifts in their preferences for muscularity following manipulation.

2.3. Study 1

2.3.1. Method

Ethics. Ethical approval for all three studies was gained from Durham University's Psychology Department Ethics Committee. Participants provided online consent before the trials began by clicking a box to confirm they had read and understood the participant information sheet and privacy notice. Participants were shown the debrief statement on screen once they had completed all trials and were provided with a web link to a popular body image support website.

Participants. An *a priori* power analysis was conducted to determine the minimum number of participants required. We based this analysis on the interaction effect (time by condition) in a study of a very similar design (Boothroyd, Tovée & Pollet, 2012) where they found a significant interaction between test phase and model size ($F_{1,52} = 23.397$, $p<0.001$, partial $\text{eta}^2 = 0.310$), with alpha set to 0.05 and power set to 0.8. This power analysis revealed a sample size of at least 92 participants was required to test for a 3-way interaction in Study 1.

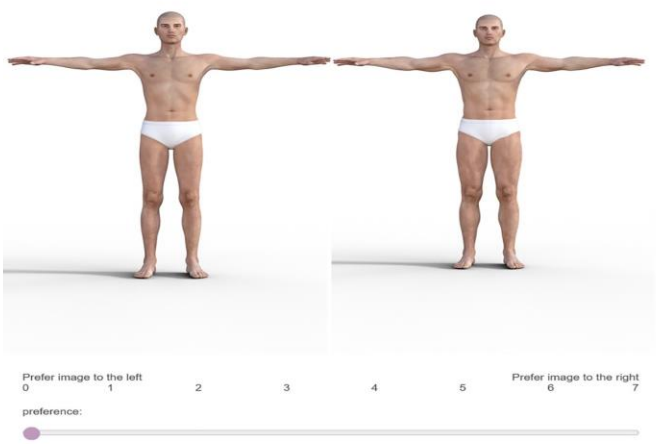
The study was conducted remotely online via Qualtrics and participants were recruited from the university's departmental participant pool, word of mouth and snowball sampling. Participants were entered into a £50 prize draw as thanks for their time and received course credits for their participation where appropriate. One-hundred and ninety (74 male and 116 female) participants were recruited, with most participants (63 men and 86 women) selecting the 18–24 and 25–30 age categories. Most participants (66 men and 102 women) reported that their sexual orientation was 'heterosexual'. The study was listed on the University's participant pool page until recruitment naturally came to a standstill. Participants were randomly allocated to one of four manipulation conditions, counterbalanced on the basis of their birth month (e.g., January, May, September = condition 1; February, June, October = condition 2; March, July, November = condition 3; April, August, December = condition 4). Participants were told that the aim of the experiment was to explore 'body preferences'. On average the study took 12.7 minutes for participants to complete.

Preference for muscularity task. The preference stimuli (12 CGI images of male bodies varying in muscle mass) were created using DAZ Studio 4.10, using the ‘Genesis 2 Base Male’ in basic white briefs. Six high muscle mass and six low muscle mass versions of this body with identical faces were created in total. The six muscular male images had the built in ’Bodybuilder’, ’Bodybuilder Details’ and ’Bodybuilder size’ slider settings set to either medium or high and the six non-muscular male images had these set to low as well as the ’Emaciated’ slider setting set to either medium or high. Each high muscle mass CGI image was randomly paired with a low muscle mass CGI image, creating 6 trials in total.

After reporting their age, gender and sexual orientation, participants were presented with 6 pairs of CGI images (presented one pair at a time) and were asked to indicate which image from each pair they preferred and the extent to which they preferred it using an 8 point slider scale from ‘0 strongly prefer left body ‘ (low muscle mass body) to ‘7 strongly prefer right body’ (high muscle mass body), with the muscular body presented to the right hand side for half of all trials and the left hand side for the remaining trials in a randomised order. An example trial from the preference task is presented in Figure 2.1.

Figure 2. 1

Example trial from the pre- and post- manipulation task.



https://doi.org/10.1371/journal.pone.0255403.g001

Overall muscularity preference scores for the pre-manipulation preference task were generated by averaging the preference scores for each of the 6 trials. A high average score indicated a preference for high muscle mass male bodies and a low score indicated a preference for low muscle mass male bodies. Participants were asked to complete this preference task again following the manipulation phase to assess whether their preference for muscularity had changed following manipulation.

Manipulation phase. Participants were told the manipulation phase of the study was designed to further explore body preferences. They were shown a series of images (presented individually) and were asked to compare each new image presented to the image seen in the preceding trial whilst indicating which one they found the most attractive (for the first image presented, participants were asked to compare it to the last viewed pre-manipulation preference phase image). The order of presentation was randomised and the purpose of asking participants to indicate preferences during this phase was simply to keep participants focused on the stimuli.

Forty-seven (19 male and 28 female) participants were allocated to condition 1 and viewed 50 aspirational high muscle mass male bodies. Forty-four (16 male and 28 female) participants were allocated to condition 2 and viewed 50 aspirational low muscle mass male bodies. Forty-five (18 male and 27 female) participants were allocated to condition 3 and viewed 48 neutral high muscle mass male bodies. Fifty-four (21 male and 33 female) participants were allocated to condition 4 and viewed 48 neutral low muscle mass male bodies.

The aspirational manipulation images (conditions 1 and 2) were photographs of attractive, high muscle mass (condition 1) and low muscle mass (condition 2) males in high status clothing and in high status postures from various male clothing websites (e.g., Father Sons Clothing and Fred Perry). Neutral manipulation stimuli were open-access images retrieved from Morrison et al. (2017). These neutral images consisted of 24 high muscle mass (condition 3) and 24 low muscle mass (condition 4) photographs of nude males, with bodies in a standard anatomical position (standing with arms out to the side, legs apart and facing the camera straight on) with faces and genitals obscured. Each of the neutral images were presented twice (once in normal alignment and once in mirror image version) to create a total of 48 images each for both condition 3 and 4. All manipulation images fell under the fair use consideration of copyright legislation at the time of study. All manipulation images were pre-rated for muscularity (on a scale of 0–10) using a sample of 15–18-year-old students (6 males and 9 females) and were then grouped accordingly (>=6/10 = high muscle mass image and <=4/10 = low muscle mass image).

Following the manipulation phase, participants were told that they needed to complete the second half of the preference task. This involved completing the same preference task as was required during the pre-manipulation preference for muscularity task.

Muscle concerns. Following the post-manipulation preference for muscularity task, participants completed the Drive for Muscularity Scale (DMS) (McCreary, 2007) a 15 item, self-report measurement in which participants indicate the extent to which a series of attitudes and behaviours are descriptive of themselves. Every item is scored on a Likert-type scale from 1 (Always) to 6 (Never) with scores reverse coded before summing responses. The 15 items are made up of attitudinal items, for example, 'I wish that I were more muscular', and behavioural items, 'I lift weights to build up muscle'. Following this final phase of the study, participants were thanked for their participation and shown the debrief statement.

2.3.2. Results

Descriptive statistics for all variables in each gender and condition are presented in Table 2.1. In order to test our main hypotheses, a mixed ANOVA was run where test phase (pre- versus post-manipulation) was a repeated measures variable, and model muscularity (high muscle mass or low muscle mass) and model valence (aspirational or neutral) were between-participant factors. Full model results are given in Table 2.2. As predicted by the visual diet hypothesis, there was a significant interaction between test phase and model muscularity ($F_{1,186}$ = 16.646, p<0.001, partial eta^2 = .082) such that preference for high muscle mass male bodies, on average, decreased following exposure to low muscle mass manipulation images. Whilst mean preference scores increased significantly following exposure to high muscle mass aspirational manipulation images, they did not, on average, increase following exposure to the neutral high muscle mass images as shown in Table

2.1 and Figure 2.2. A post-hoc paired-samples t-test revealed a significant difference between mean pre- and post-manipulation muscularity preference scores for those viewing low muscle mass males in conditions 2 and 4 ($t(96) = 4.658$, p = < .000) but no such significant difference for those viewing high muscle mass images in conditions 1 and 3 ($t(92) = -1.079$, $p = .283$). The significant result for condition 2 survived when p values were corrected for multiple comparisons (using adjusted p = 0.025 for 2 tests).

Table 2. 1

Tabulated mean (standard deviation) pre- and post-manipulation preference for muscularity scores, and total drive for muscularity scale scores (DMS) for each gender across the four manipulation conditions.

Condition	Gender	Mean pre-manipulation preference	Mean post-manipulation preference	Mean total DMS score
1	Male (N = 19)	5.386 (1.087)	5.483 (1.211)	49.421 (14.037)
	Female (N = 28)	4.411 (1.479)	4.756 (1.241)	31.821 (10.555)
2	Male (N = 18)	5.188(.913)	4.781 (1.018)	47.625 (13.038)
	Female (N- = 28)	4.774 (1.332)	4.601 (1.410)	26.000 (8.890)
3	Male (N = 18)	4.824 (1.235)	4.787 (1.196)	43.611 (18.363)
	Female (N = 27)	4.792 (1.326)	4.679 (1.555)	30.250(9.610)
4	Male (N = 21)	5.175 (1.031)	4.691 (1.407)	44.095 (13.490)
	Female (N = 33)	4.417 (1.487)	3.912 (1.590)	28.250 (9.873)

https://doi.org/10.1371/journal.pone.0255403.t001

Table 2. 2

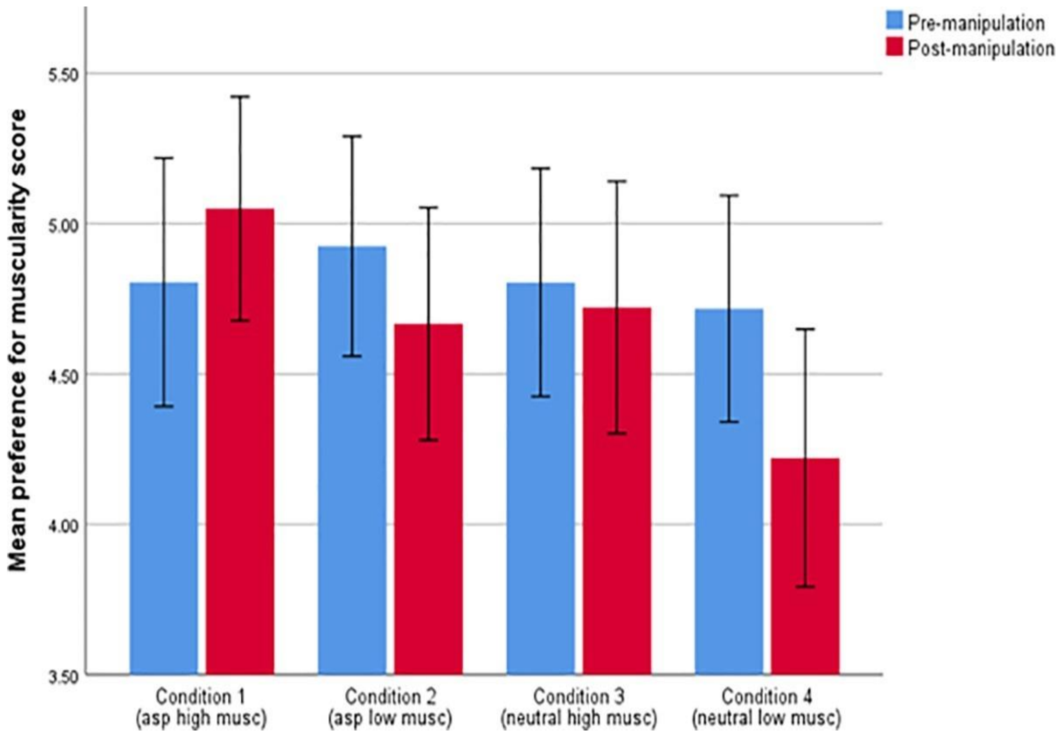
Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and model muscularity (high muscle mass or low muscle mass) and model valence (aspirational or neutral) as between-participant factors. Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp2
Phase	1, 186	6.982	0.009	0.036
Valence	1, 186	1.694	0.195	0.009
Muscularity	1, 186	1.272	0.261	0.007
Valence*Muscularity	1, 186	0.185	0.668	0.001
Phase*Valence	1, 186	6.388	0.012	0.033
Phase*Muscularity	**1, 186**	**16.646**	**<0.000**	**0.082**
Phase*Valence* Muscularity	**1, 186**	**0.156**	**0.693**	**0.001**

https://doi.org/10.1371/journal.pone.0255403.t002

Figure 2. 2

Mean preference for muscularity score for the pre- and post-manipulation preference phases for each of the 4 experimental conditions, with 95% confidence intervals, and where 3.50 represents no preference to either image presented.



https://doi.org/10.1371/journal.pone.0255403.g002

In contrast to the associative learning hypothesis, there was no significant three-way interaction between phase, model muscularity and model valence ($F_{1,186} = 0.156$, $p = 0.693$, partial eta$^2 = .001$) as shown in Table 2.2, such that the phase and model muscularity interaction held for both aspirational and neutral manipulation conditions. As shown in Figure 2.2 however, although the effect of phase was more negative for participants in the low muscle mass conditions than in the high muscle mass conditions, this did not translate into participants in both high muscle mass conditions showing an increase in muscularity preferences. In fact, participants in the neutral high muscle mass condition showed no change over time.

When gender or DMS score was added to the model, results did not change; there was still a significant interaction between phase and muscularity and there was no higher order interaction with either gender nor DMS (see Table 2.3 below).

Table 2. 3

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and model muscularity (high muscle mass or low muscle mass), model valence (aspirational or neutral) and participant gender (Model 1) as between-participant factors, Drive for Muscularity scale scores (DMS) added as a covariate (Model 2) or both gender and DMS added to the model (Model 3). Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	*ηp2*
Model 1				
Phase	1, 182	7.599	0.006	0.04
Valence	1, 182	1.902	0.17	0.01
Muscularity	1, 182	1.072	0.302	0.006
Gender	1, 182	6.782	0.01	0.036
Valence*Muscularity	1, 182	0.017	0.898	0.000
Valence*Gender	1, 182	0.164	0.686	0.001
Muscularity*Gender	1, 182	0.036	0.85	0.000
Muscularity*Valence*Gender	1, 182	2.694	0.102	0.015
Phase*Valence	1, 182	4.684	0.032	0.025
Phase *Muscularity	**1, 182**	**16.128**	<**0.000**	**0.081**
Phase*Gender	1, 182	0.692	0.407	0.004
Phase*Valence*Muscularity	**1, 182**	**0.153**	**0.696**	**0.001**
Phase*Valence*Gender	1, 182	1.566	0.212	0.009
Phase*Muscularity*Gender	1, 182	0.007	0.932	0.000
Phase*Valence*Muscularity*Gender	1, 182	0.023	0.88	0.000
Model 2				
Phase	1, 182	1.783	.183	0.010
DMS	1, 182	33.102	<0.000	0.154
Muscularity	1, 182	0.655	0.420	0.004
Valence	1, 182	0.426	0.515	0.002
Valence *Muscularity	1, 182	2.020	0.157	0.011
Muscularity*DMS	1, 182	1.236	0.268	0.007
Valence*DMS	1, 182	0.107	0.744	0.001
Valence*Muscularity*DMS	1, 182	1.373	0.243	0.007
Phase*DMS	1, 182	0.218	0.641	0.001
Phase*Muscularity	**1, 182**	**8.218**	**0.005**	**0.043**
Phase*Valence	1, 182	7.829	0.006	0.041
Phase*Muscularity*Valence	**1, 182**	**0.146**	**0.703**	**0.001**
Phase*Muscularity*DMS	1, 182	1.942	0.165	0.011
Phase*Valence*DMS	1, 182	3.816	0.052	0.021
Phase*Valence*Muscularity* DMS	1, 182	0.024	0.876	0.000
Model 3				
Phase	1, 178	3.938	0.049	0.022
DMS	1, 178	20.838	<0.000	0.105

Muscularity	1, 178	0.679	0.411	0.004
Valence	1, 178	0.338	0.562	0.002
Gender	1, 178	0.984	0.322	0.006
Muscularity*Gender	1, 178	0.772	0.381	0.004
Valence*Gender	1, 178	0.200	0.656	0.001
Muscularity*DMS	1, 178	1.861	0.174	0.010
Valence*DMS	1, 178	0.214	0.644	0.001
Muscularity*Gender*DMS	1, 78	1.540	0.216	0.009
Valence*Gender*DMS	1, 178	0.302	0.583	0.002
Phase*Muscularity	**1, 178**	**7.919**	**0.005**	**0.043**
Phase*Valence	1, 178	3.836	0.052	0.021
Phase*Gender	1, 178	0.956	0.330	0.005
Phase*DMS	1, 178	2.777	0.097	0.015
Phase*Muscularity*Gender	1, 178	0.319	0.573	0.002
Phase*Valence*Gender	1, 178	0.464	0.497	0.003
Phase*Muscularity*DMS	1, 178	2.744	0.099	0.015
Phase*Valence*DMS	1, 178	2.137	0.146	0.012
Phase*Muscularity* DMS*Gender	1, 178	0.013	0.911	0.000

https://doi.org/10.1371/journal.pone.0255403.t003

2.3.3. Study 1 interim discussion

Study 1 aimed to explore the mechanisms underpinning changes in preferences for muscularity across a Western sample. Four manipulation conditions were created to assess the extent to which visual diet or associative learning mechanisms best explained such changes in body preferences. Overall, the findings provide evidence for the visual diet hypothesis for low muscle mass images in particular.

Under the visual diet hypothesis, viewing high (versus low) muscle mass male bodies should cause a shift in preference towards higher muscle mass male bodies irrespective of whether or not that image is of a positive or neutral valence. The current findings somewhat support this prediction as exposure to low muscle mass males decreased later preferences for muscularity irrespective of whether male bodies were of a positive or neutral valence. Exposure to high muscle mass males increased preferences for muscularity under some circumstances (i.e., when these images were of a positive valence as in condition 1) but not others (i.e., when these high muscle mass males were of a neutral valence, as in condition 3, exposure to such males did not increase preferences for muscularity). One may explain such findings in the context of associative learning mechanisms; the stimuli used in condition 3 were of a neutral rather than positive valence and, according to the associative learning hypothesis, neutral males should have little to no effect on one's later preference for muscularity. However, this fails to explain why the neutral images, used in condition 4, changed preference for muscularity so drastically (a bigger change in preference than any of the changes observed under the aspirational conditions). Indeed, we found no significant three-way interaction between phase, muscularity and valence, such that the interaction between phase and muscularity held for both aspirational and neutral images.

When gender was added as an additional predictor, there was still a significant interaction between phase and muscularity but there were no higher order interactions (see Table 2.3), suggesting that males and females are equally prone to visual diet effects. Furthermore, consistent with other research where body dissatisfaction had no effect on weight adaptation effects in women (Boothroyd, Tovée & Pollet, 2012), the exploratory analyses of Study 1 suggest a participant's Drive for Muscularity score does not affect how likely they are to change their muscularity preferences following exposure to males of either high or low muscle mass. This goes against findings of some of the previously cited work (Glauert et al, 2009; Stephen et al., 2018), where authors noted that participants with pre-existing body concerns were more susceptible to visual adaptation effects in the body size dimension. We will consider the possible explanations of this null effect as part of our later discussion.

Study 1 shows good support for the effects of visual diet for low muscle mass images, but it could be argued that associative learning may still take place in circumstances where visual diet is not in effect (Boothroyd, Tovée & Pollet, 2012). With this in mind, we conducted a second study in which visual diet effects were impossible, yet associative learning effects could still arise. Specifically, Study 2 explored whether exposure to an equal number of aspirational high muscle mass and neutral low muscle mass male bodies (condition 5) decreased or increased preferences for muscularity, as well as whether exposure to an equal number of aspirational low muscle mass and neutral high muscle mass male bodies (condition 6) decreased or increased preferences for muscularity.

2.4. Study 2

2.4.1. Method

Participants. For Study 2, we aimed to exceed the number of participants recruited in a previous study of very similar design (Boothroyd, Tovée & Pollet, 2012) and that of previous muscularity adaptation work (e.g., Sturman et al., 2017). We therefore recruited 84 (31 men and 53 women) participants with a mean age of 31 (SD = 12.06) and this exceeds the number of participants required for a two-way interaction using the power analysis that we ran for Study 1. Participants were recruited through the university's departmental participant pool, word of mouth and snowball sampling. 89% of the sample reported that they were exclusively heterosexual. Prior to the pre-manipulation preference for muscularity task, participants were randomly allocated to one of two manipulation conditions. Participants were told that the aim of the experiment was to explore 'body preferences'. On average the study took 9 minutes and 30 seconds for participants to complete. Participants were entered into a £50 prize draw as a thank you for their time.

Stimuli. Stimuli from Study 1 were pre-rated for muscularity and valence in order to select the most appropriate stimuli for Study 2. Thirty-two (6 male and 26 female) 18-year-old participants (all but one exclusively heterosexual) responded to the pre rating survey. Participants were asked to 'Rate each image in terms of whether you think men would aspire to be like this person (e.g., in style and status) from 0 (I don't think men would at all aspire to be this person) to 10 (men would definitely aspire to be like this person)' and to 'Rate each image in terms of how muscular you find the body from 0 (not at all muscular) to 10 (extremely muscular)'. Using these data we selected the most appropriate images to use in Study 2 (24 aspirational high muscle mass images, 24 neutral low muscle mass images, 24 aspirational low muscle mass images and 24 neutral high muscle mass images). The mean ratings for valence and muscularity across each of these stimuli categories are presented in Table 2.4.

Procedures. Procedures matched those described for Study 1, with the only change being to the manipulation conditions. In Study 2 participants were randomly assigned to one of two manipulation conditions. Condition 5 involved 44 (19 male and 25 female) participants viewing 24 aspirational high muscle mass male bodies and 24 neutral low muscle mass male bodies. Condition 6 involved 40 (12 male and 28 female) participants viewing 24 aspirational low muscle mass male bodies and 24 neutral muscular males. All manipulation images were presented in a randomised order.

Table 2. 4

Results from the pre-rating task: Mean ratings for valence and muscularity for each of the 24 selected images across each of the 4 stimuli categories.

Stimuli for Study 2	Aspirational high muscle (Condition 5)	Neutral low muscle (Condition 5)	Aspirational low muscle (Condition 6)	Neutral high muscle (Condition 6)
Mean valence rating (max = 10)	7.590	2.648	5.268	4.708
Mean muscularity rating (max = 10)	7.337	2.272	2.906	4.840

https://doi.org/10.1371/journal.pone.0255403.t004

2.4.2. Results

Descriptive statistics outlining the average pre- and post- manipulation preferences for muscularity scores, and average total DMS scores, by gender and condition are presented in Table 2.5. A mixed ANOVA with test phase (pre- versus post-manipulation) as a repeated measures variable and condition (condition 5 versus condition 6) as the between-participant factor showed a significant interaction between test phase and condition ($F_{1,82} = 8.690$, $p < .005$, partial $eta^2 = .096$) such that condition 6 manipulation stimuli (aspirational non-muscular and neutral muscular male images) decreased preferences for muscularity to a greater extent than the condition 5 manipulation stimuli (made up of aspirational muscular and neutral non-muscular male images). Mean post-manipulation changes in muscularity preference for each of the two conditions are presented in Figure 2.3 and the tabulated values for the mixed ANOVA are shown in Table 2.6. A post-hoc paired-samples t-test revealed a significant difference between mean pre- and post-manipulation muscularity preference scores for condition 6 ($t(39) = 4.621$, $p = < .000$), but not for condition 5 ($t(43) = .618$, $p = .540$).

Further analyses also revealed a three-way interaction between phase (pre-versus post-manipulation preference score), condition and gender ($F_{1,80} = 4.204$, $p < .045$, partial eta$^2 = .050$) as shown in Table 2.7. Gender differences in muscularity preference score, pre- and post-manipulation for both conditions are shown in Figure 2.4.

Table 2. 5

Tabulated mean (standard deviation) pre- and post-manipulation preference for muscularity scores, and total DMS scores for each gender across the two manipulation conditions.

Condition	Gender	Mean pre-manipulation preference	Mean post-manipulation preference	Mean total DMS score
5	Male (N = 19)	4.833 (1.442)	5.053 (1.115)	44.211 (15.747)
	Female (N = 25)	4.760 (1.276)	4.480 (1.342)	30.160 (8.275)
6	Male (N = 12)	5.139 (.819)	4.528 (1.216)	41.917 (10.396)
	Female (N = 28)	4.738 (1.393)	4.268 (1.739)	31.357 (12.284)

https://doi.org/10.1371/journal.pone.0255403.t005

Table 2. 6

Tabulated values for mixed ANOVA with phase (pre- versus post- manipulation preference for muscularity scores) as the repeated measures variable and condition (condition 5 versus condition 6) as the between-participants factor. Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp2
Phase	1, 82	14.403	<0.000	0.149
Condition	1, 82	0.298	0.587	0.004
Phase*Condition	**1, 82**	**8.690**	**0.004**	**0.096**

https://doi.org/10.1371/journal.pone.0255403.t006

Table 2. 7

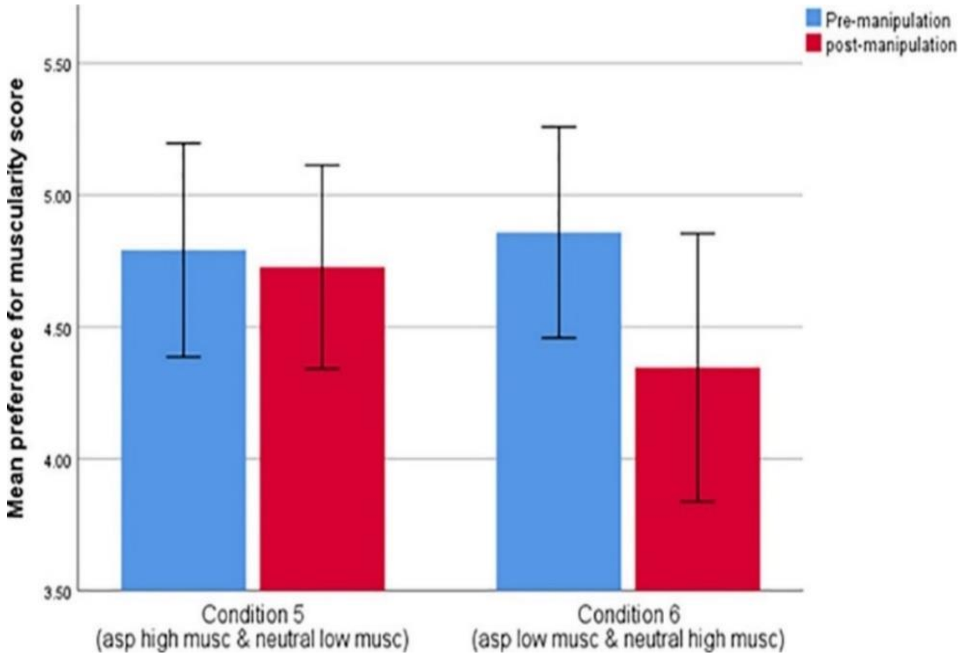
Tabulated values for mixed ANOVA with phase (pre- versus post- manipulation preference for muscularity scores) as the repeated measures variable, and condition (condition 5 versus condition 6) and gender (male versus female) as between-participant factors. Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp2
Phase	1, 80	13.379	0	0.143
Condition	1, 80	0.138	0.711	0.002
Gender	1, 80	1.147	0.287	0.014
Condition*Gender	1, 80	0.000	0.99	0.000
Phase*Condition	**1, 80**	**10.686**	**0.002**	**0.118**
Phase*Gender	1, 80	1.318	0.254	0.016
Phase*Condition*Gender	**1, 80**	**4.204**	**0.044**	**0.050**

https://doi.org/10.1371/journal.pone.0255403.t007

Figure 2. 3

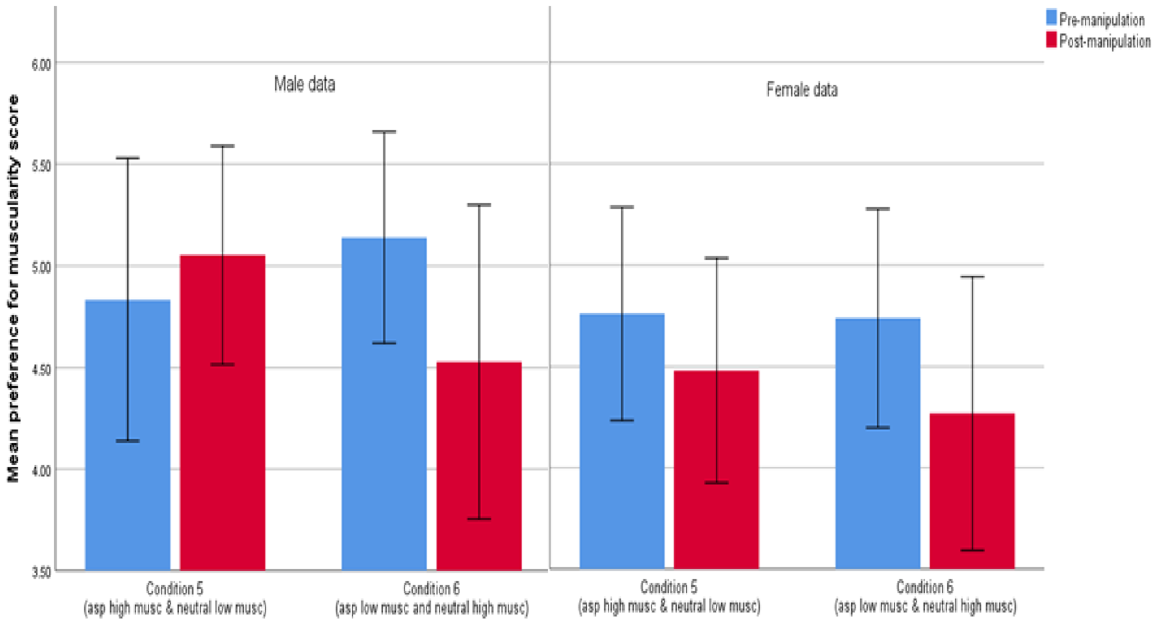
Mean changes in preference for muscularity following manipulation across each of the two conditions, with 95% confidence intervals, and where 3.50 represents no preference to either image presented.



https://doi.org/10.1371/journal.pone.0255403.g003

Figure 2. 4

Mean preference for muscularity score for the pre- and post-manipulation preference phases for each of the 2 experimental conditions split by gender, with 95% confidence intervals, and where 3.50 represents no preference to either image presented.



https://doi.org/10.1371/journal.pone.0255403.g004

When male and female data were split and analysed separately the mixed ANOVA analysis for females showed no significant interaction between test phase and condition ($F_{1,51} = 1.000$, p = .322, partial eta^2 = .019). However, the analysis for male data did show a significant interaction between phase and condition ($F_{1,29} = 11.799$, p < .003, partial eta^2 = .289). Paired-sample t-tests revealed a significant difference between mean pre- and post-manipulation muscularity preference scores for condition 6 (t(11) = 2.916, p = .014) but no such significant differences for condition 5 (t(18) = 1.570, p = .134).

A further mixed ANOVA analysis on combined male and female data, with DMS score added to the model, revealed no significant interactions (and indeed the main interaction of interest became marginal). Tabulated values for the male data mixed ANOVA are presented below in Table 2.8 below.

Table 2. 8

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable and condition as the between-participants factor and DMS as a covariate for male data. Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp2
Phase	1, 27	0.272	0.606	0.010
DMS	1, 27	6.179	0.019	0.186
Condition	1, 27	0.129	0.722	0.005
Condition*DMS	1, 27	0.142	0.709	0.005
Phase*DMS	1, 27	0.897	0.352	0.032
Phase*Condition	**1, 27**	**3.211**	**0.084**	**0.106**
Phase*Condition* DMS	1, 27	0.758	0.392	0.027

https://doi.org/10.1371/journal.pone.0255403.t008

A mixed ANOVA analysis with test phase (pre- versus post-manipulation) as a repeated measures variable, DMS score, condition (condition 5 versus condition 6) and gender as the between-participant factors revealed a significant interaction between phase and condition ($F_{1,76} = 4.483$, p = < .039, partial eta^2 = .056) but no other significant interactions. Findings are presented in Table 2.9. Further, no significant interactions were found when male and female data were isolated and analysed separately.

Table 2. 9

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and condition and participant gender as between-participant factors with DMS as covariate. Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp2
Phase	1, 76	0.028	0.866	0.000
Condition	1, 76	0.078	0.781	0.001
Gender	1, 76	0.307	0.581	0.004
DMS	1, 76	5.975	0.017	0.073
Condition*Gender	1, 76	0.573	0.451	0.007
Condition*DMS	1, 76	0.120	0.730	0.002
Condition*Gender*DMS	1, 76	0.500	0.608	0.013
Phase*DMS	1, 76	1.426	0.236	0.018
Phase*Condition	**1, 76**	**4.483**	**0.038**	**0.056**
Phase*Gender	1, 76	0.425	0.516	0.006
Phase*Condition*Gender	1, 76	0.496	0.483	0.006
Phase*Condition*DMS	1, 76	1.708	0.195	0.022
Phase*Condition*Gender*DMS	1, 76	0.011	0.989	0.000

https://doi.org/10.1371/journal.pone.0255403.t009

2.4.3. Study 2 interim discussion

Overall, Study 1 findings showed some support for the visual diet hypothesis but the role of associative learning was less clear. Study 2 therefore introduced two further manipulation conditions, in which visual diet effects would be impossible, yet associative learning effects might still arise (equal exposure to muscular and non-muscular male bodies of differing valence). Study 2 data does show a significant interaction between test phase and condition such that condition 6 manipulation stimuli significantly decreased preferences for muscularity, but condition 5 manipulation stimuli did not. Such findings suggest that associative learning mechanisms can, to some extent, underpin changes in body preferences for male muscularity. The condition 6 findings specifically cannot be explained by the visual diet hypothesis, but rather must be the result of participants responding to the positive valence of the non-muscular male bodies and shifting their preferences accordingly (associative learning).

However, we note that viewing aspirational, high muscle mass males together with neutral low muscle mass males (condition 5) did not increase preferences for muscularity as would be expected under the associative learning hypothesis. Rather, preferences stayed roughly the same following manipulation. Interestingly these findings are very similar to those reported in a previous paper where researchers report that aspirational large images together with non-aspirational thin images decreased preferences for thinness, whilst exposure to aspirational thin images together with non-aspirational large images resulted in no significant changes in preferences for thinness (Boothroyd Tovée & Pollet, 2012). Our condition 5 results may be due to the same phenomenon hypothesised by Boothroyd and colleagues in this paper: perhaps there were no significant changes under condition 5 because preference for muscularity was already high to begin with (pre-manipulation), because the Western sample used in the current study already inhabited an environment dominated by positive associations with muscularity in males. The aspirational high muscle mass trials therefore represented our sample's pre-existing environment with limited scope for preferences for muscularity to increase any further post-manipulation.

Having said this, we found a significant interaction between phase, condition and gender and, when this interaction was explored further (by breaking data down into male and female data sets and analysing separately), results showed it was the male sample who provided more obvious evidence for associative learning mechanisms underpinning changes in body preferences. One explanation for this gender difference is social comparison processes (Festinger, 1954), in which males identify with, preferentially focus upon, and compare themselves to, other males of a positive valence. If males preferentially focused on the positively valenced over the neutral images in each manipulation condition, this would explain why their preferences shifted in the direction of these aspirational/ positive valence manipulation images (as opposed to shifting in the direction of the neutral images) as predicted under the associative learning hypothesis. Additionally, aspirational images were retrieved from male clothing websites and thus the images were intended to be appealing to male (as opposed to female) viewers specifically which could, again, explain why associative learning effects were more pronounced for males in this case. Because stimuli was made up of male (vs female) bodies, the female sample were less likely than males to identify with, and thus attend to, aspirational manipulation stimuli. This may explain why associative learning effects were less pronounced for female participants.

Consistent with Study 1 data and previous published findings by Boothroyd, Tovée and Pollet (2012) in which body concerns did not influence preference changes, findings from Study 2 showed that Drive for Muscularity scores did not influence the extent of changes in muscularity preferences following manipulation: analyses revealed no significant interactions between test phase, condition and Drive for Muscularity. We acknowledge, however, that participants completed the DMS at the end of the survey and exposure to stimuli in the many body preference trials may have temporarily affected participants' body concerns. Indeed, exposure to muscular images can increase feelings of dissatisfaction following exposure (Arbour & Ginis, 2006; Cramblitt & Pritchard, 2013). Asking participants to complete the DMS before the preference trials began may, in hindsight, have been a better method.

Whilst manipulation images were pre-rated for muscularity and valence in an attempt to select the most appropriate stimuli for Study 2, the raters were mostly (>80%) female (opportunity sample). It is worth noting, therefore, that these ratings may be biased towards the female perspective. We should not automatically assume that males would offer similar ratings here and therefore we recommend that those who replicate our work using the same stimuli should re-run the ratings task with more male raters to see if similar ratings of both muscularity and valence are obtained with such a sample.

2.5. Study 3

As mentioned in our introduction, studies entailing repeated exposure to similar stimuli may result in demand characteristics, specifically participants discerning the intention of the study and consciously shaping their responses. With this in mind, a third study was conducted (Study 3) in which 'distractor images' were presented alongside the idealised manipulation images of bodies to lessen the potential influence of demand characteristics. Study 3 aimed to explore whether adaptation still occurred when manipulation image bias towards a particular body type was more subtle.

2.5.1. Method

Participants. From an initial sample of 96 responses, 12 low quality participant responses were excluded from analysis for selecting the same response on all trials. This left us with a sample of 84 (45 men and 39 women) participants aged between 18 and 30 with a mean age of 25 (SD = 3.84) who were recruited for Study 3 through a participant recruitment website. 77% of the sample reported that they were exclusively heterosexual. Participants were randomly allocated to one of two manipulation conditions. Participants were told that the aim of the experiment was to explore ‘body preferences’. Participants received course credits where appropriate to thank them for their participation. The sample size for Study 3 exceeds the number of participants used in a previous muscularity adaptation experiments (Sturman et al., 2017). Further, sample size here exceeds the number of participants required for a two-way interaction using the power analysis run for Study 1.

Stimuli. Manipulation stimuli were made up of both photographs and CGI images. The photographs were the same as those used as neutral images in both Studies 1 and 2, whilst the CGI images used in manipulation as well as in both the pre- and post- preference for muscularity trials of Study 3 were created using DAZ Studio 4.10, using the ‘Genesis 2 Base Male’ in basic white briefs. These CGI images were created such that the high muscle mass CGI images were less muscular than those equivalent high muscle mass CGI images used in Study 1 and 2. This meant that any muscularity differences between high and low muscle mass CGI images in Study 3 were more subtle and reduced the likelihood of demand characteristics affecting results.

Procedures. Procedures largely mirrored those implemented in Studies 1 and 2: participants completed the pre-manipulation preference for muscularity task, followed by the manipulation phase and then the post-manipulation preference for muscularity task.

Participants were randomly assigned to one of two manipulation conditions. Condition A involved 41 (22 male and 19 female) participants viewing 48 (38 photographs and 10 CGI) high muscle mass images together with 22 (16 photographs and 6 CGI) low muscle mass male images. Condition B involved 43 (23 male and 20 female) participants viewing 48 (38 photographs and 10

CGI) low muscle mass images together with 22 (16 photographs and 6 CGI) high muscle mass male images. Images were presented in a randomised order.

2.5.2. Results

A mixed ANOVA with test phase (pre- versus post-manipulation) as a repeated measures variable and condition (condition A versus condition B) as the between-participants factor showed a significant interaction between test phase and condition ($F_{1,82} = 9.612$, $p < .004$, partial eta2 = .105) such that condition A manipulation stimuli (48 high muscle and 22 low muscle mass images) increased preferences for muscularity, and condition B stimuli (48 low muscle and 22 high muscle mass images) decreased preferences for muscularity. Mean pre- and post-manipulation levels of muscularity preference for each condition are shown in Figure 2.5 and the tabulated values for the mixed ANOVA are presented in Table 2.10 under 'Model 1'.

Table 2. 10

Tabulated values for mixed ANOVA with phase (pre- versus post- manipulation preference for muscularity scores) as the repeated measures variable and condition (condition A versus condition B) as the between-participants factor (Model 1) with gender added as an additional between-participants factor (Model 2). Critical tests of our hypotheses are shown in bold.

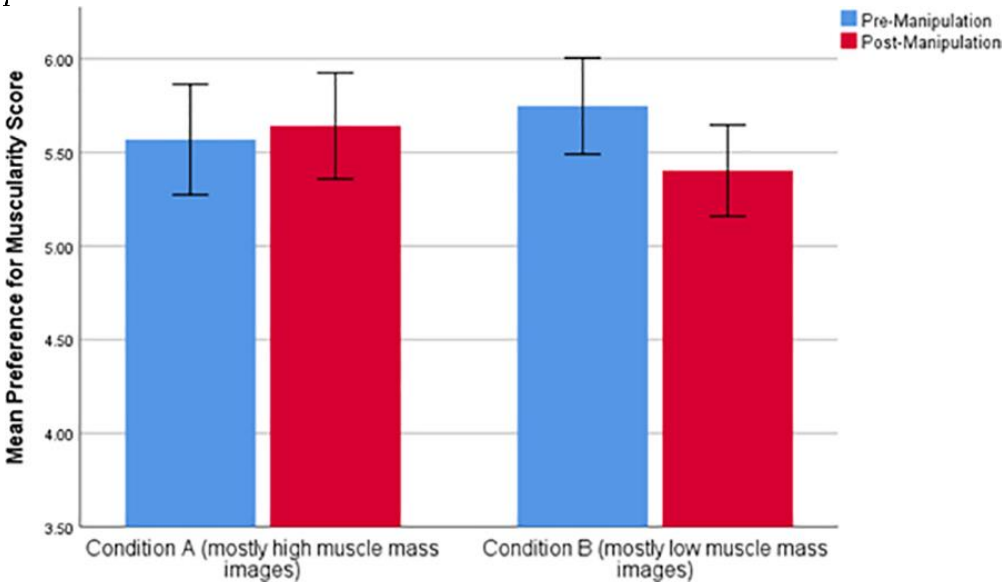
Source	*df*	*F*	*p*	ηp2
Model 1				
Phase	1, 82	4.061	0.047	0.047
Condition	1, 82	0.290	0.865	0.000
Phase*Condition	**1, 82**	**9.612**	**0.003**	**0.105**
Model 2				
Phase	1, 80	3.909	0.051	0.047
Condition	1, 80	0.025	0.875	0.000
Gender	1, 80	0.943	0.334	0.012
Phase*Condition	**1, 80**	**9.480**	**0.003**	**0.106**
Phase*Gender	1, 80	0.016	0.899	0.000
Condition*Gender	1, 80	0.018	0.893	0.000
Phase*Condition*Gender	1, 80	0.096	0.757	0.001

https://doi.org/10.1371/journal.pone.0255403.t010

There were no higher order interactions when gender was added to the model (see 'Model 2' in Table 2.10). A post-hoc paired-samples t-test revealed a significant difference between mean pre-and post-manipulation muscularity preference scores for condition B ($t(42) = 3.299$, $p = .002$), but no such significant difference exists under condition A ($t(40) = .872$, $p = .389$). The significant result for condition B survived when p values were corrected for multiple comparisons (using adjusted $p = 0.025$ for 2 tests).

Figure 2. 5

Mean changes in preference for muscularity following manipulation across each of the two conditions, with 95% confidence intervals, and where 3.50 represents no preference to either image presented.



https://doi.org/10.1371/journal.pone.0255403.g005

2.5.3. Study 3 interim discussion

Overall, Study 3 findings showed that when manipulation image bias is more subtle (i.e., when distractor images were presented alongside the manipulation images), preferences still shifted in the direction of the most prevalent (manipulation) image. This finding is of particular interest given the fact that most previous adaptation work has been designed with an obvious bias towards a particular image type as part of manipulation, rendering it vulnerable to the effects of demand characteristics (Want, 2014). Study 3 findings suggested that demand characteristics were unlikely to have confounded results in previous studies of adaptation as preferences for muscularity, in this study, shifted even when bias was so subtle that it was unlikely to be detected. Crucially, this mirrors the results of studies making use of manipulation imagery with an obvious skew towards a certain image type, thus suggesting that demand characteristics likely did not confound the findings of such studies, though we note that further replications of Study 3 are necessary to be more certain of this.

We note that Study 3 manipulation involved participants viewing images that were biased towards one particular body type of either high (condition A) or low (condition B) muscle mass. For example, 69% of manipulation images were of high muscle mass and 31% were of low muscle mass under condition A (and vice versa in condition B). Future work could explore just how subtle this bias in image type can be in order for changes in body type preferences to still be observed.

2.6. General discussion

The primary purpose of this research was to explore whether changes in preferences for muscularity in male bodies across a male and female sample was best explained by visual diet, associative learning mechanisms, or a mixture of the two. Study 1 provided evidence for the visual diet hypothesis, though the role of associative learning was less clear. Study 2 explored changes in muscularity preferences in a context in which visual diet effects would be impossible, yet associative learning effects could still arise. It showed that associative learning mechanisms also influenced changes in preferences for muscularity, in that exposure to aspirational non-muscular male bodies, alongside neutral muscular male bodies lead to a decrease in preference for muscularity. Phase and muscularity interactions were evident in every study.

This paper also explored whether demand characteristics were likely to have confounded the findings of previous adaptation experiments as proposed by previous authors in the field (Want, 2014). Study 3 showed that even when manipulation images are only subtlety skewed towards a particular body type (i.e., when potential demand characteristics are reduced), muscularity preferences still shifted towards the most prevalent image type shown as part of manipulation. This suggested that demand characteristics were unlikely to have confounded the results of previous adaptation experiments with more obvious manipulation image bias. Though, as previously mentioned, to be sure of this conclusion, replications are necessary.

CGI images used in the pre- and post-manipulation muscularity preference trials were highly controlled, with only muscularity manipulated. Although these images were very realistic, it could be argued that it would have been more ecologically valid to use real photographs naturally varying in muscularity or one photograph counter-manipulated in the muscularity dimension. This is something we would encourage others to consider when using similar experimental procedures in the future.

For Studies 1 and 2, both sets of neutral manipulation stimuli were photographs of nude males in the standard anatomical position with faces and genitals obscured, whereas faces were not obscured in the aspirational manipulation stimuli. Lack of consistency in facial cue availability is unlikely to have affected our results because eye tracking evidence shows that participants' first fixations almost always land on the face, but are followed very quickly by fixations on the upper chest and pelvic regions of nude and clothed same and opposite sex human figures (Nummenmaa et al., 2012). This, together with the fact participants were repeatedly instructed to compare each *body* to the one previously seen for every trial during the manipulation phase suggests the lack of consistency in facial cue availability across conditions is unlikely to be a confound. Having said this, we do acknowledge that to rule it out as a confound altogether we would need to re-run our studies either using eye tracking equipment such that we could confirm participants' focus was on bodies or indeed ensuring all stimuli had faces obscured for consistency across the manipulation trials.

Nummenmaa et al. (2012) have also presented eye tracking evidence to show that nude stimuli receive more fixations than clothed. The nude (neutral condition) images used in the current study may therefore be more salient than the clothed aspirational ones which may explain why the visual adaptation effect was particularly strong for condition 4 (neutral, low muscle mass condition). Although if this was the case, we would also expect visual adaptation effects to be larger for condition 3 (neutral, nude, high muscle mass) than for condition 1 (aspirational, clothed, high muscle mass), as well as finding condition 5 (aspirational clothed high muscle mass and neutral nude low muscle mass) to significantly decrease muscularity preferences following manipulation and condition 6 (aspirational, clothed low muscle mass and neutral nude high muscle mass) to significantly increase them, yet we did not find this. Such findings therefore suggest nudity is unlikely to have confounded results. Having said this, as with facial cue availability, we cannot completely rule out nudity as a confounding factor. As such, future work may seek to explore whether findings replicate when the valence of imagery is altered through means other than high status clothing, for example, through varying health cues or facial expression perhaps.

Neutral manipulation images were not necessarily of a negative valence, for example, the neutral high muscle mass images were likely to be somewhat aspirational, given that muscularity on its own is an aspirational trait. This makes it difficult to compare the manipulation effects of neutral muscular images to the manipulation effects of aspirational muscular images (given that even such neutral images are somewhat aspirational). However, we considered this potential flaw prior to conducting Study 2 and thus ran a pre-rating task in which all stimuli used in Study 1 were rated in terms of how aspirational and how muscular each image was. For the Study 2 manipulation stimuli, the neutral images had mean valence ratings significantly lower than the mean valence ratings for the aspirational conditions as shown in Table 2.4. This means we had separate, clearly defined stimulus categories for high muscle mass and low muscle mass bodies that differed in terms of valence.

However, we also note (as shown in Table 2.4), that within the high muscle mass stimuli, the aspirational high muscle mass images had higher ratings of muscularity (mean value = 7.337) than the neutral high muscle mass images (mean value = 4.840). Mean values for muscularity within the low muscle mass stimuli were roughly the same, with a mean value muscularity score of 2.906 for the aspirational low muscle mass group and a mean score of 2.272 for the neutral low muscle mass group. Because the high muscle mass stimuli categories had different muscularity ratings across the aspirational and neutral high muscle mass conditions, this should be considered as a potential confound. Differences in such ratings may explain Study 1 findings in which participants' preference for muscularity increased following exposure to aspirational muscular males but failed to show such an increase for neutral high muscle mass images (see Figure 2.2), in that adaptation to muscularity was stronger in cases where high muscle mass was more obvious. Further, the lower ratings of muscularity for the neutral high muscle mass stimuli may explain condition 6 findings, in that these images were not sufficiently muscular to counter the effects of the aspirational non-muscular images.

Having said this, high mean ratings of muscularity for the aspirational high muscle mass stimuli did not appear to counter the effects of neutral low muscle mass images in condition 5. It is therefore unlikely that the differences in muscularity ratings across the aspirational and neutral high muscle mass groups are the primary reason for our findings. Further, whilst neutral high muscle mass images may have had lower muscularity ratings than the aspirational high muscle mass images, we argue that all high muscle mass images (whether neutral or aspirational/high valence) are of a more muscular physique than you would expect to see in most of our average raters/participants or their immediate social circle. Though we do note that future work in this area should make use of better matched stimuli for muscularity.

We recognise muscle mass and fat mass as having very different associations with health in males, yet being highly correlated (due to larger people having more fat and muscle). However, adaptation research has shown that fat and muscle mass are encoded separately because participants' points of subjective normality shifted in the direction of the manipulation images along the relevant (fat or muscle) axis (Sturman et al, 2017). Although, the authors of this paper provide support for the visual diet hypothesis, they did not manipulate the valence of their stimuli and thus any associative learning effects were not clear. The current study has already explored the mechanisms underpinning changes in muscularity preferences using low muscle mass and high muscle mass male bodies (each with low fat mass) for stimuli, but we do not know whether associative learning effects are apparent using male body stimuli of differing BMI and valence and we therefore propose that this should be a future area of focus. Similarly, when exploring adaptation effects using female body stimuli, work has already explored the internal underlying mechanisms underpinning changes in female BMI preferences (Boothroyd Tovée & Pollet, 2012), however, future work should seek to explore whether such mechanisms also underpin shifts in preferences for muscularity using female body stimuli despite the fact that muscularity is an aspirational trait primarily associated with male bodies. Such findings will allow us to establish whether associative learning effects are only apparent when sex-specific body traits, such as high muscularity and low BMI, are assigned to the appropriate sex manipulation image bodies (e.g., high muscle mass males and low BMI females).

2.7. Conclusion

In summary, our findings provide evidence for the visual diet hypothesis with some evidence for associative learning mechanisms. A primary implication of our findings is that media promotion of unrealistically muscular, unhealthily proportioned male bodies is likely to be increasing personal preferences for male muscularity in both men and women. High status male figures in the media are unrepresentatively muscular (Law & Labre, 2002; Leit, Pope & Gray, 2001), and exposure to such figures may be affecting perceptions of the ‘normal’ male body. Future work should build upon our current findings and should establish the foundations of mechanistic interventions to reduce the negative impact of ubiquitous hypermuscular male body images in the media.

Chapter 3.

Internalisation of cultural body ideals, perceived pressures to achieve such ideals and shifts in preferences for muscularity

This chapter describes Study 4 which sought to replicate the musculature preference shift effects observed in Studies 1, 2 and 3, whilst also building upon such work by examining whether one's pre-existing internalisation of cultural body ideals and perceived pressures to achieve such ideals (as measured by one's SATAQ-4 score) could predict the strength of any such preference changes. Participants (80 men and 84 women) completed the SATAQ-4 before viewing 48 manipulation images of either low (condition 1) or high (condition 2) muscle mass male bodies. Preferences for muscularity were recorded before and after exposure to such manipulation images. Study 4 findings were in line with those of Studies 1, 2 and 3 in that they have revealed further evidence that viewing high (low) muscle mass images of males can increase (decrease) men and women's preferences for muscularity. Furthermore, Study 4 findings revealed that those men with high total SATAQ-4 and/or Pressures-Peers SATAQ-4 subscale scores were more likely than those with lower scores to experience such preference changes.

3.1. Introduction

3.1.1. Visual diet and body preferences

As discussed in the previous chapter, an individual's visual diet, that is their consumption of perceptual information including body types, has been shown to influence one's perception of a 'normal' body in lab-based settings (e.g., Brooks et al, 2020a; Glauert et al., 2009; Stephen et al., 2018; Stephen et al., 2019; Sturman et al., 2017). Indeed, the visual diet hypothesis predicts that one's body ideal is malleable in that it will shift based on what body types the individual is most frequently exposed to (Boothroyd, Tovée & Pollet, 2012).

Such visual diets are influenced by the body ideals that prevail in Western media and, as previously noted, much of this is dominated by low BMI females (Fouts and Burggraf, 1999; Mastro,

& Figueroa-Caballero, 2018) and highly muscular males (Boyd & Murnen, 2017; Dallesasse & Kluck, 2013; Leit, Pope, & Gray, 2001; Law & Labre, 2002; González et al., 2020; Pope et al, 1999). Viewing such idealised images can lead to strong internalisation of cultural body ideals which can increase body dissatisfaction in young women (e.g., Groesz, Levine & Murnen, 2002; Nouri, Hill & Orrell-Valente, 2011), and men (Barlett et al., 2008; Blond, 2008; Cramblitt & Pritchard, 2013; Duggan & McCreary, 2004; Hargreaves & Tiggemann, 2009; Hatoum & Belle, 2004; Hausenblas et al., 2013; Leit et al., 2002; Lorenzen et al., 2004; Morry & Staska, 2001; Mulgrew & Volcevski-Kostas, 2012; Mulgrew & Cragg, 2017; Sylvia et al., 2014; Young, Gabriel & Hollar, 2013).

Cross-cultural research comparing groups within non-Western cultures who either have access to, or reduced access to, Western media show that those who *can* access this visual diet show stronger preferences for low BMI female bodies compared to those with reduced media access (Boothroyd et al., 2016; Jucker et al., 2017). Notably, such work revealed that television consumption was a *stronger* predictor of body weight preferences than acculturation, education, hunger, income (Boothroyd et al., 2016), and nutritional status and food insecurity (Jucker et al., 2017). In terms of the muscular male body ideal, Thornborrow et al. (2020) found that more TV viewing and greater media internalisation was associated with a more muscular body ideal amongst men from both WEIRD (Western, Educated, Industrialized, Rich, Democratic) and non-WEIRD populations. Such cross-cultural work suggests that it is one's visual diet that can shape their body type preferences.

3.1.2. Male Musculature perceptual changes

This thesis has already engaged with the current work on the effects of image exposure on body size/shape perception. This research has, for example, shown that viewing thin (overweight) bodies can lead to an over-estimation (underestimation) of one's own body size (Brooks et al., 2016; Brooks et al., 2018; Glauert et al., 2009; Winkler & Rhodes, 2005), and can increase (decrease) preferences for thinness (Boothroyd, Tovée & Pollet, 2012), as well as distorting one's perception of a 'normal' (Brooks et al, 2020a; Glauert et al., 2009; Stephen et al., 2018; Stephen et al., 2019; Sturman et al., 2017) and ideal (Glauert et al., 2009) body such that this becomes thinner (larger).

This thesis has also outlined the limited equivalent work on men that has previously focused on perceptual changes in the body fat dimension (e.g., Stephen et al., 2018). Thus far, there have only been two laboratory-based aftereffects studies exploring whether exposure to bodies of varying muscle mass can subsequently distort one's perception of 'normal' levels of muscularity; Sturman et al. (2017) and Brooks et al. (2020a), with details of such research provided in Chapter 1. Whilst this work begins to explore the neglected area of perceptions of male muscularity, and how such perceptions may be malleable, these studies have their limitations. For example, authors only measured how image exposure could affect one's perception of normal levels of muscle mass, and, as detailed in Chapter 1, it is argued that an important direction for future research is to explore whether this image exposure can also affect one's *preferences* for muscularity specifically. Furthermore, Sturman et al. (2017) only tested 64 participants (only 25 of which were men). Brooks et al. (2020) tested more (64 men and 64 women), though 64 of these participant responses came from those whose data had already been analysed by Sturman et al. (2017). Moreover, despite the fact that equivalent research in the body fat dimension has shown that body dissatisfied men and women are more susceptible to shifts in perceptions of body fat normality (e.g., Stephen et al., 2018), authors of the equivalent musculature work did not seek to explore whether similar susceptibilities exist when it comes to musculature perceptions. Crucially therefore, as a means to build upon current findings, Study 4 seeks to examine whether the strength of any observed changes in musculature preferences following manipulation image exposure can be predicted by one's pre-existing body image concerns. Notably, the current research aims to measure changes in musculature *preferences* specifically, and to recruit at least 80 men and 80 women such that the Study 4 sample size exceeds that of previously cited musculature perception shift work (e.g., Brooks et al., 2020; Sturman et al., 2017) and equivalent work exploring body fat perceptual changes (e.g., Stephen et al., 2018).

3.1.4. Whose male musculature preferences are more likely to shift?

As previously noted, much of the body perception manipulation literature fails to examine any individual differences. Knowing who may be susceptible to the potentially negative consequences of viewing idealised bodies, like those that prevail in Western media, has important implications. Specifically, knowing who is vulnerable would allow us to best target intervention at these individuals as a means to prevent the maintenance or even the intensification of the unrealistic male body standards in these individuals. The research thus far that has explored such susceptibilities (with the exception of Boothroyd, Tovée & Pollet, 2012) has revealed that body dissatisfied individuals experience stronger shifts in perceptions of body normality following the viewing of thin manipulation images in samples of women (Glauert et al., 2009), and in samples of women *and* men (Stephen et al., 2018), with Stephen et al. (2018) concluding that increased visual attention towards idealised bodies mediated the relationship between body dissatisfaction and susceptibility to the body size adaptation effect in both men and women. However, there is a lack of work exploring whether similar individual differences exist in relation to male musculature preference shifts specifically. Whilst there is some evidence that body image concerns predict attentional bias towards muscular male bodies over non-muscular ones (Cho & Lee, 2013; House et al, 2023; Jin et al., 2018), at the time of writing, there are no studies that explore whether pre-existing body image concerns can predict musculature preference judgments in men and women. This is therefore a neglected area of research that Study 4 seeks to address.

Whilst Stephen et al. (2018) measured body image disturbance via a one-item measure of body dissatisfaction, Study 4 sought to measure one's body image in a more comprehensive way with a multi-item questionnaire that should better capture the nuanced factors that may contribute to one's body image. Specifically, Study 4 measured participants' internalisation of cultural body ideals and the pressure they felt to achieve such ideals using the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4; Thompson et al, 2011). Such measures are a key risk factor for body image disturbance. Indeed, for women at least, those most affected by the thin ideal depicted in Western media tend to be those women who already have high thin-ideal internalisation (Stice et al., 2001). When it comes to muscularity, internalised preferences for high muscle mass bodies mediate the relationship between media consumption and drive for muscularity in both men and women (Cramblitt & Pritchard, 2013).

3.1.5. The current study

Both men and women were asked to complete the SATAQ-4 (Thompson et al, 2011) as a way of measuring baseline internalisation of cultural body ideals and pressures to achieve such ideals. They were then randomly assigned to one of two manipulation conditions which involved participants viewing either 48 low muscle mass male bodies (condition 1) or 48 high muscle mass bodies (condition 2). It was predicted that exposure to muscular (non-muscular) male bodies would cause a shift in preference towards muscular (non-muscular) male bodies, and that this shift would likely be stronger in those with higher SATAQ-4 scores.

Specifically, this study aimed to determine whether certain individuals were more susceptible to musculature preference shifts following manipulation image viewing over others. The first hypothesis was that exposure to muscular male bodies would increase preferences for muscularity, whilst exposure to non-muscular male bodies would decrease preferences for muscularity. The second hypothesis was that individuals who experience high sociocultural internalisation and/or pressure to adhere to cultural body norms would be more susceptible to any such shifts in preferences.

3.2. Method

3.2.1. Ethics

Ethical approval was gained from Durham University's Psychology Department Ethics Committee. Participants were asked to provide consent before the trials began by clicking a box to confirm they had read and understood the information sheet and privacy notice. Participants were shown the debrief statement once they had completed all trials and were provided with a web link to a popular body image support website. They were also provided with the lead researcher's email should they have had any questions.

3.2.2. Participants

The study was conducted remotely online, and participants were recruited from Durham University's departmental participant pool, word of mouth and snowball sampling. One hundred and sixty-five (80 male, 84 female and 1 'other') participants were recruited, and they were aged between 18-45 (M=20, SD=2.75), with most participants (92.5%) stating their sexual orientation as 'heterosexual'. Participants were randomly assigned to one of two manipulation conditions in which they either viewed 48 low muscle mass male body stimuli (condition 1) or 48 high muscle mass male body stimuli (condition 2).

3.2.3. Internalisation of cultural body ideals and pressure to achieve such ideals

After providing their age, gender and sexual orientation, participants completed the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4) (Thompson et al, 2011). As outlined in Chapter 1, this is a 22 item, self-report measurement in which participants are asked to indicate the extent to which a series of items are descriptive of themselves. Every item is scored on a Likert-type scale from 1 (Definitely Disagree) to 5 (Definitely Agree). The SATAQ-4 measures two distinct constructs: internalisation of cultural body ideals and the pressure one feels to achieve such ideals. Indeed, the 22 items making up the SATAQ-4 can be further divided into 5 main subscales; 'Internalisation-Thin/Low Body Fat' (e.g. "I think a lot about looking thin"), 'Internalisation-Muscular/Athletic' (e.g. "I think a lot about looking muscular"), 'Pressures- Family' (e.g. "Family members encourage me to get in better shape"), 'Pressures-Peers' (e.g. "My peers encourage me to get thinner"), and 'Pressures-Media' (e.g. "I feel pressure from the media to improve my appearance"). A high SATAQ-4 score indicates stronger internalisation of Western body ideals and/or more perceived pressure to be thin/muscular.

3.2.4. Pre-manipulation preference for muscularity task

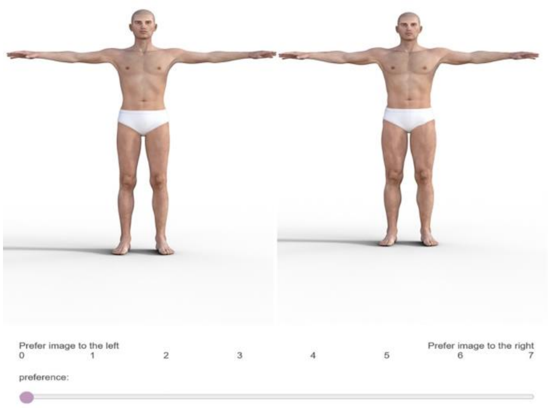
Following completion of the SATAQ-4 questionnaire, participants completed the first preference for muscularity task. The preference stimuli (6 high and 6 low muscle mass CGI stimuli) were the same as those used in the preference trials of Studies 1, 2 and 3 described in the previous chapter.

Participants were presented with 6 pairs of these CGI images (presented one pair at a time) and were asked to indicate which image from each pair they preferred and the extent to which they preferred it using an 8-point slider scale from '0 strongly prefer left body ' (low muscle mass body) to '7 strongly prefer right body' (high muscle mass body), with the muscular body presented to the right hand side for half of all trials and the left hand side for the remaining trials in a randomised order. An example preference task trial is shown in Figure 3.1.

Overall muscularity preference scores for the pre-manipulation preference task were generated by averaging the preference scores for each of the 6 trials (reverse scoring was used for trials where high muscle mass male images were presented to the left). A high average score indicated a preference for high muscle mass male bodies whilst a low score indicated a preference for low muscle mass male bodies. Participants were asked to complete this preference task again following the manipulation phase to assess whether their preference for muscularity had changed following the manipulation phase.

Figure 3. 1

Example trial from the pre- and post- manipulation preference task.



3.2.5 Manipulation phase

Participants were told the manipulation phase of the study was designed to further explore body preferences. They were shown a series of images (presented individually) and were asked to compare each new image presented to the image previously seen whilst indicating which one they found the most attractive. Specifically, participants had to view an individual image on screen, before selecting a response from two options: ‘I preferred the previous image’ or ‘I prefer the new image below’. For the first manipulation phase image presented, participants were asked to compare it to the last viewed pre-manipulation preference phase image that they had preferred. The order of presentation was fully randomised and the purpose of asking participants to indicate preferences during this phase was simply to keep participants focused on the stimuli presented. Stimuli remained on screen until participants provided their preference response.

Eighty-one participants (38 men and 43 women) were randomly allocated to condition 1 where they viewed 48 low muscle mass male bodies. Eighty-four participants (42 men, 41 women, and one participant who selected ‘other’ as their gender) were randomly allocated to condition 2 where they viewed 48 high muscle mass male bodies. The manipulation images included a mixture of photographs and CGI images of low muscle mass (condition 1) and high muscle mass (condition 2) males presented in a randomised order. As noted in Chapter 1, Western media presents *both* real and CGI bodies, and thus the mixed stimuli types as part of Study 4's stimulus presentation design were intended to best mimic this sort of exposure. The CGI images were those individual images used in the preference for muscularity trials (6 high and 6 low muscle mass). Each CGI image was presented twice in original and twice in mirror-image form to create 24 low muscle mass (condition 1) and 24 high muscle mass (condition 2) manipulation CGI images. The photographs were those used as neutral images in Studies 1, 2 and 3 (as described in Chapter 2). These were open access images (Morrison et al., 2017) of 24 low muscle mass (condition 1) and 24 high muscle mass (condition 2) photographs of nude males, with bodies in a standard anatomical position (standing with arms out to the side, legs apart and facing the camera straight on), with faces and genitals obscured. These images had been pre-rated for muscularity in a previous study (on a scale of 0-10; ≥6/10= high muscle mass image and ≤4/10= low muscle mass image; Jacques et al., 2021).

Following the manipulation phase, participants were told that they needed to complete the second half of the preference task (the post-manipulation preference for muscularity task), where the pre-manipulation preference for muscularity task was repeated. Following this final phase of the study, participants were thanked for their participation and shown the debrief statement.

3.3. Results

A mixed ANOVA on all data where test phase (pre- versus post-manipulation) was a repeated measures variable, and condition (low muscle mass or high muscle mass condition) was a between-participant factor, revealed a significant interaction between test phase and condition ($F_{1,163}$=28.599, p<0.001, partial eta^2=.149) such that preference for high muscle mass male bodies, on average, increased following exposure to high muscle mass manipulation images (condition 2) and decreased following exposure to low muscle mass manipulation images (condition 1). Full model results are presented in Table 3.1 below and a visual display of mean changes in preferences across each of the 2 conditions is presented in Figure 3.2. A post-hoc paired-samples t-test revealed a significant difference between pre- and post-manipulation preference for muscularity scores for those viewing low muscle mass male bodies in condition 1 (t (80) = 4.256, p< .001) and those viewing high muscle mass male bodies in condition 2 (t (83) = -3.193, p=.002). These significant results survived when p values were corrected for multiple comparisons (using adjusted p= 0.025 for 2 tests).

Table 3. 1

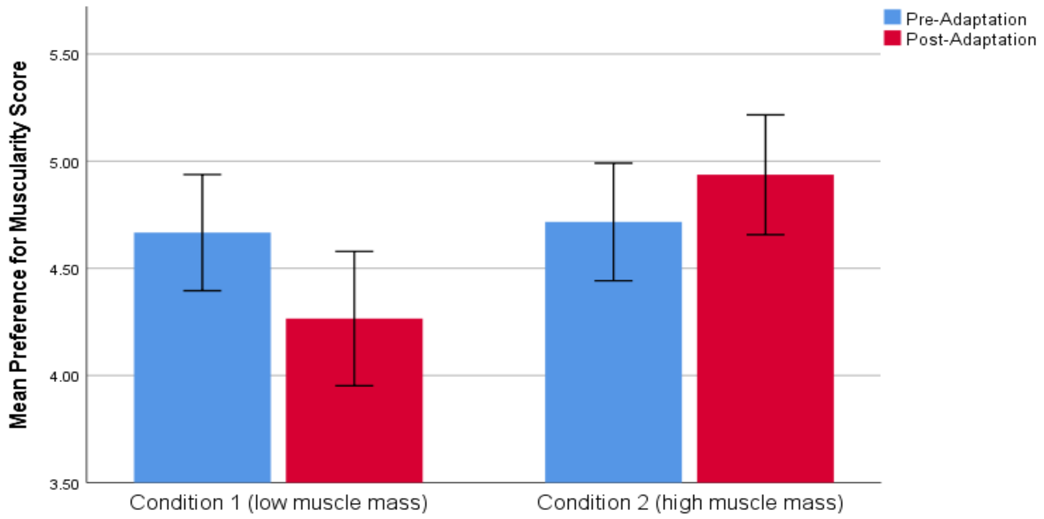
Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and condition (condition 1: low muscle mass or condition 2: high muscle mass) as a between-participant factor. Critical tests are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Phase	1,163	2.426	0.121	0.015
Condition	1,163	3.450	0.065	0.934
Phase*Condition	**1,163**	**28.599**	**0.000****	**0.149**

**p<.05, **p<.01.*

Figure 3. 2

Mean preference for muscularity scores for the pre- and post-manipulation preference phases for each of the experimental conditions, with 95% confidence intervals.



When gender was added to the model (and data for the one participant who stated ‘other’ for their gender was removed), results did not change; there was still a significant interaction between phase and condition ($F_{1,160}$=29.016, p<.001, partial eta^2=.154). There was no higher order interaction with gender (see ‘Model 1’ in Table 3.2). When Total SATAQ-4 score was added to the model there was no significant interaction between phase and condition, nor were there any higher order interactions involving SATAQ-4 score (see ‘Model 2’ in Table 3.2). However, there *was* a significant four-way interaction between phase, condition, gender and Total SATAQ-4 scores $F_{1,156}$=7.107, p=.008, partial eta^2=.044) (see ‘Model 3’ in Table 3.2).

Table 3. 2

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable and condition as the between subjects factor with gender as a between-participants factor (Model 1), Total SATAQ-4 score added as a covariate (Model 2) or both gender as a between subjects factor and Total SATAQ-4 as a covariate (Model 3). Critical tests are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Model 1				
Phase	1,160	2.670	.104	.016
Condition	1,160	3.697	.056	.023
Gender	1,160	30.396	.000**	.160
Condition*Gender	1,160	.960	.329	.006
Phase*Condition	**1,160**	**29.016**	**.000****	**.154**
Phase*Gender	1,160	1.676	.197	.010
Phase*Condition*Gender	**1,160**	**1.161**	**.283**	**.007**
Model 2				
Phase	1,161	1.861	.174	.011
Condition	1,161	.424	.516	.003
Total SATAQ-4	1,161	3.410	.067	.021
Condition*Total-SATAQ-4	1,161	.087	.769	.001
Phase*Condition	**1,161**	**.208**	**.649**	**.001**
Phase*Total SATAQ-4	1,161	2.924	.089	.018
Phase*Condition*Total SATAQ-4	**1,161**	**.392**	**.532**	**.002**
Model 3				
Phase	1,156	3.191	.076	.020
Condition	1,156	2.115	.148	.013
Gender	1,156	3.797	.053	.024
Total SATAQ-4	1,156	2.215	.139	.014
Condition*Gender	1,156	2.183	.142	.014
Condition*Total-SATAQ-4	1,156	1.192	.277	.008
Gender*Total-SATAQ-4	1,156	.772	.381	.005
Condition*Gender*Total-SATAQ-4	1,156	2.795	.097	.018
Phase*Condition	**1,156**	**.388**	**.534**	**.002**
Phase*Gender	1,156	.128	.721	.001
Phase*Total SATAQ-4	1,156	4.849	.029	.030
Phase *Condition*Gender	**1,156**	**5.603**	**.019**	**.035**
Phase*Gender*Total SATAQ-4	1,156	.007	.933	.000
Phase*Condition*Total SATAQ-4	**1,156**	**.202**	**.653**	**.001**
Phase*Condition*Gender*Total SATAQ-4	**1,156**	**7.107**	**.008****	**.044**

**p<.05, **p<.01.*

To investigate this four-way interaction, data for men was analysed on its own and here analyses revealed a significant interaction between test phase and condition for men ($F_{1,78}$ =22.664, p<0.001, partial eta^2=.225), such that preference for high muscle mass male bodies, on average, increased following exposure to high muscle mass manipulation images (condition 2) and decreased following exposure to low muscle mass manipulation images (condition 1). Full model results are presented in Table 3.3 under ‘Model 1’.

Table 3. 3

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable and condition as the between subjects factor for men (Model 1) and women (Model 3), with total SATAQ-4 score added as a covariate for men (Model 2) and women (Model 4). Critical tests are shown in bold.

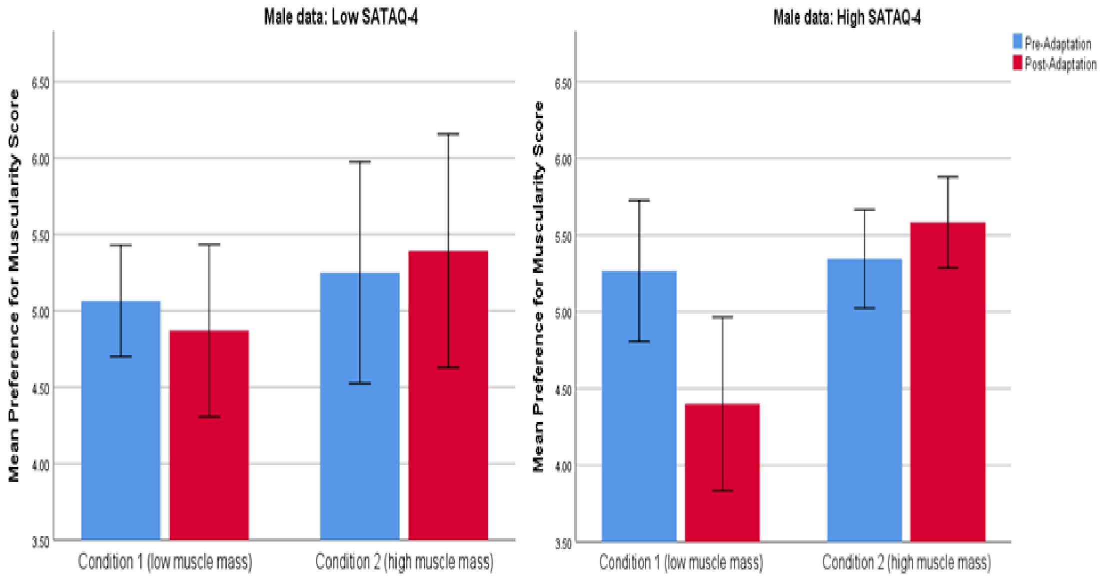
Source	*df*	*F*	*p*	ηp^2
Model 1 (male data)				
Phase	1,78	4.653	.034*	.056
Condition	1,78	6.102	.016	.073
Phase*Condition	**1,78**	**22.664**	**.000****	**.225**
Model 2 (male data)				
Phase	1,76	1.308	.256	.017
Condition	1,76	.000	.984	.000
Total SATAQ-4	1,76	.298	.587	.004
Condition*Total-SATAQ-4	1,76	.270	.605	.004
Phase*Condition	**1,76**	**1.949**	**.167**	**.025**
Phase*Total SATAQ-4	1,76	2.908	.092	.037
Phase*Condition*Total SATAQ-4	**1,76**	**6.219**	**.014***	**.076**
Model 3 (female data)				
Phase	1, 82	.054	.817	.001
Condition	1, 82	.348	.557	.004
Phase*Condition	**1, 82**	**8.691**	**.004***	**.096**
Model 4 (female data)				
Phase	1, 80	1.854	.177	.023
Condition	1, 80	3.039	.085	.037
Total SATAQ-4	1, 80	1.963	.165	.024
Condition*Total-SATAQ-4	1, 80	2.676	.106	.032
Phase*Condition	**1, 80**	**3.608**	**.061**	**.043**
Phase*Total SATAQ-4	1, 80	2.089	.152	.025
Phase*Condition*Total SATAQ-4	**1, 80**	**1.964**	**.165**	**.024**

$*p<.05$, $**p<.01$.

A post-hoc paired-samples t-test revealed a significant difference between pre- and post-manipulation preference for muscularity scores for those men viewing low muscle mass males in condition 1 (t (37) = 3.866, p< .001) and those viewing high muscle mass male bodies in condition 2 (t (83) = -2.603, p=.013). When total SATAQ-4 score was added to the model there was a significant three-way interaction between phase, condition and SATAQ-4 scores ($F_{1,76}$ =6.291, p=.014, partial eta^2=.076) (see Table 3.3 under 'Model 2'). Figure 3.3. below provides a visual display of men's changes in musculature preferences across the two manipulation conditions split by those who scored higher than the sample mean (M=66) on the SATAQ-4, and those who scored lower or the same as this sample mean.

Figure 3. 3

Men's mean preference for muscularity scores for the pre- and post-manipulation preference phases for each of the experimental conditions for high and low SATAQ-4 score groups, with 95% confidence intervals.



When data for women was analysed on its own, analyses revealed a significant interaction between test phase and condition for women ($F_{1,82}$ =8.691, p=.004, partial eta^2=.096). Full model results are presented in Table 3.3 under 'Model 3'. A post-hoc paired-samples t-test revealed a significant difference between pre- and post-manipulation preference for muscularity scores for those women viewing low muscle mass males in condition 1 (t (42) = 2.188, p=.034) but no significant difference between pre- and post-manipulation preference muscularity scores for those viewing high muscle mass male bodies in condition 2 (t (40) = -1.986, p= .054). When total SATAQ-4 score was added to the model for female data there was no significant three-way interaction between phase, condition and SATAQ-4 scores (see Table 3.3 under 'Model 4').

Given that the SATAQ-4 measures two distinct constructs: Internalisation of cultural body ideals and the pressure one feels to achieve such ideals, we sought to determine which subscale of the SATAQ-4 was driving the strength of men's preference changes for male muscularity. When each of the SATAQ-4 subscales were added to the model, the only significant interaction was between phase, condition and the Pressures-Peers SATAQ-4 subscale component ($F_{1,76}$=10.937, p=.001, partial eta^2=.126) as presented in Table 3.4 below. Non-significant interactions involving all other SATAQ-4 subscales for men are presented in Appendix A.

Table 3. 4

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, condition as the between subjects factor, and the Pressures-Peers component of the SATAQ-4 score as a covariate for men. Critical tests are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Phase	1,76	.059	.808	.001
Condition	1,76	.979	.325	.013
Pressures-Peers	1,76	.768	.383	.010
Condition*Pressures-Peers	1,76	.019	.892	.000
Phase*Condition	**1,76**	**1.270**	**.263**	**.016**
Phase*Pressures-Peers	1,76	1.860	.177	.024
Phase*Condition*Pressures-Peers	**1,76**	**10.937**	**.001****	**.126**

**p<.05, **p<.01.*

3.4. Discussion

The purpose of this study was to explore musculature preferences and to examine whether certain individual's musculature preferences were more easily manipulated than others. Specifically, it was predicted that those with higher total SATAQ-4 scores (those who internalise cultural body ideals and/or feel more pressure to achieve such ideals) would be more susceptible to musculature preference changes following manipulation image presentation than those with lower total SATAQ-4 scores. Overall, findings showed that viewing muscular (non-muscular) male bodies increased (decreased) preferences for muscular bodies. This is in line with the findings of previous research that measured shifts in one's point of subjective normality for muscle mass (Sturman et al., 2017 & Brooks et al., 2020a). Further, Study 4 findings are in line with the musculature preference shift findings reported in Chapter 2 in that Study 4 *also* revealed evidence that viewing high (low) muscle mass male bodies could increase (decrease) one's *preferences* for muscularity. In terms of enhanced susceptibility to such preference shifts, in line with previous work focusing on susceptibility to strength of body fat perceptual shifts (e.g., Glauert et al., 2009; Stephen et al., 2018), Study 4 findings showed that higher SATAQ-4 scores in men positively predicted the strength of any changes in male musculature preferences. Specifically, there was a significant three-way interaction between phase, condition and SATAQ-4 scores for men but not for women, such that men with high SATAQ-4 scores experienced more of a decrease in their muscularity preferences in condition 1 (exposure to low muscle mass manipulation images) and more of an increase in their muscularity preferences in condition 2 (exposure to high muscle mass manipulation images) than those men with lower SATAQ-4 scores. Because the SATAQ-4 measures two distinct constructs (internalisation of cultural body ideals and pressures to achieve such ideals), we sought to explore which specific SATAQ-4 subscale was driving the stronger preference shift amongst high total SATAQ-4 score men. Analyses revealed that the Pressures-Peers SATAQ-4 subscale component was the only subscale component to significantly interact with phase and condition, and thus was the only component to predict the strength of musculature preference changes following manipulation image viewing.

It is not surprising that SATAQ-4 scores predicted male musculature preference changes for men and not women given that the manipulation images were made up solely of male bodies. As such, women in the sample would be less likely to identify with these images and, thus, even if they had strongly internalised cultural body ideals and/or were experiencing a strong pressure to achieve such ideals, they would not necessarily be expected to pay more attention to such muscular male imagery and thus would not be more susceptible to musculature preference changes over women who are low SATAQ-4 scorers. Indeed, whilst not exploring any susceptibilities related to one's body image disturbance, Brooks et al. (2020) *did* find shifts in perceptions of normality to be stronger in own-gender stimuli than in other-gender stimuli.

In line with the work of Stephen et al (2018) in which they conclude body image disturbance predicts strength of body size perceptual changes, we too find evidence that constructs associated with one’s body image (e.g., internalisation of cultural body ideals and pressures to achieve such ideals) may influence the extent to which manipulation body stimuli can affect our perceptions of, and specifically preferences for, musculary. However, whilst Stephen et al (2018) used eye tracking such that they could conclude that increased visual attention to idealised bodies mediated the relationship between body image disturbance and changes in one’s perception of normal fat mass, the current study, being conducted remotely online, was unable to explore such mediating factors. However, this is an interesting direction for future research and, indeed, Study 9 (presented in Chapter 5) seeks to explore this, examining attentional bias towards muscularity and subsequent shifts in preferences for muscularity using eye tracking.

A potential limitation of Study 4 is in relation to the stimuli used. Specifically, manipulation images were made up of *both* CGI and photographs Whilst we purposely chose mixed stimuli of this kind to best mimic the variety of high (and low) muscle mass male figures depicted in Western media, these stimuli were not matched for superficial information such as height, ethnicity, and body hair which arguably could have affected the strength of any preference shift results. Further, all images used portrayed men with low body fat percentages which meant that even in the low muscularity conditions, at least a very slight level of muscular definition would be visible. As a result, the low muscularity images may have inadvertently been considered to have a desirable level of muscularity. Additionally, the high muscularity real images were visibly less muscular than the high muscularity CGI images. Although, all high muscle mass images used in this study (whether photographs or CGI) are of a more muscular physique than you would expect to see in most of the average raters/participants or their immediate social circle. Nevertheless, future work may seek to ensure that photographs and CGI stimuli are better matched for perceived muscularity, as well as for superficial features such as body hair and ethnicity to eliminate any effects of these on the strength of musculature preference shifts.

In summary, we found exposure to high (low) muscle mass male bodies increase (decrease) preferences for such body types. This data is the first of its kind to show that SATAQ-4 scores can positively predict the strength of shifts in musculature preferences in men, such that high SATAQ-4 scorers showed stronger shifts than low SATAQ-4 scorers. Specifically, it seems to be the Pressures-Peers component of the SATAQ-4 that could be driving this enhanced susceptibility to preference shift changes. A primary implication of Study 4 findings is that media promotion of unrealistically muscular, unhealthily proportioned male bodies is likely to be increasing personal preferences for male muscularity in both men and women. And, in those men who are already experiencing body image disturbance, exposure to such media could be increasing personal preferences for muscularity even further such that any body image disturbance continues to be maintained, or perhaps intensified, overtime. As such, findings suggest that any intervention aimed at reducing the negative impact of idealised Western media image exposure would perhaps be best targeted at this group as a means to prevent the further development of the unrealistic standards of the male body in such individuals.

Chapter 4.

Body cognitions, attitudes towards muscularity, and manipulation of male musculature preferences amongst 6-18-year-old boys and girls

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As previously noted in Chapter 1, children's male body ideals are vastly understudied. To address this gap, three samples of children (102 male and 102 female 11- to 18-year-olds, 52 male and 49 female 6- to 11-year-olds, and 89 male 8- to 14-year-olds) took part in three overlapping studies which are presented in this chapter as Studies 5, 6 and 7. These studies sought to explore body cognitions, attitudes towards muscularity and manipulation of male musculature preferences in 6-18-year-olds. Study 5 examined the age profiles of internalisation of cultural body ideals and drive for muscularity, while Study 6 tested whether children's preferences for high/low muscularity images could be manipulated via viewing biased selections of stimuli, and whether age and/or sociocultural/muscularity attitudes predicted susceptibilities to such visual diet effects. Further, Study 7 required children from all three samples to provide free-text responses regarding their perception of images of men high or low in muscularity. Findings revealed that 11–18-year-olds showed stronger sociocultural attitudes (for boys and girls) and drive for muscularity (boys only) in Study 5, and stronger baseline preferences for muscularity in Study 6 (boys and girls) with increasing age. Viewing images of high (low) muscle mass male bodies increased (decreased) one's later preferences for muscularity, although it was only older boys (those aged 15-18-years old) who showed this effect when data was broken down by gender and age. In Study 7, all age groups frequently referred to the athletic physique of high muscle mass males, and the high approachability and intelligence of low muscle mass males.

4.1. Introduction

4.1.1. Background

As briefly summarised in Chapter 1, most of the child and adolescent body ideals literature has focused exclusively on girls: both their desire to be thin, and their preferences for low BMI female bodies. For example, girls as young as five and six show evidence of restrictive eating, body dissatisfaction, and preference for the thin body ideal (Davison, Markey & Birch, 2000; Dohnt & Tiggemann, 2006b; Damiano et al., 2015). In girls it is known that both body image disturbance- that is the distorted perception of how one views their own body- and body dissatisfaction, can often occur well before the onset of puberty, and gradually become more pronounced as girls move through adolescence (Ricciardelli & McCabe, 2001b; Thompson & Chad, 2000; Calzo, et al., 2012). Indeed, Volpe et al. (2016) found the average age of onset for anorexia and bulimia nervosa was around 18-years-old. Though, authors point out a bimodal distribution for anorexia nervosa exists, with peak early onset at 16.7 years-old and peak late onset at 25.3 years-old.

Children and adolescent body image research has recently started to focus on the neglected area of male body ideals. As previously noted, the current Western cultural ideal for males is the muscular, mesomorphic body shape, and this it is this body type that is often over-represented in Western media (Leit, Pope, & Gray, 2001; Law & Labre, 2002). Many boys and young men desire, and often fail to achieve, this unrealistic level of muscularity, which can lead to body dissatisfaction (Thompson et al., 1999b; Dittmar, 2005). Indeed, research has shown that pre-adolescent boys seek to increase muscle mass (McCabe, & Ricciardelli, 2003), boys as young as six aspire to possess muscular figures (McLean, Wertheim & Paxton, 2018; McCabe & Ricciardelli, 2005; Ricciardelli & McCabe, 2001b) and 8–12-year-olds report engagement in muscle building strategies (McCabe & Ricciardelli, 2005). In terms of how children report to perceive bodies, the focus here has historically been on their perceptions of body stimuli varying in fat mass specifically (e.g., Kraig & Keel, 2001; Hill & Silver, 1995), and so the equivalent research examining perceptions of muscularity in male body stimuli has been neglected. Studies from the 1960s and 70s have shown that boys as young as five and six assign favourable adjectives to low-quality mesomorph male body silhouettes and unfavourable adjectives to ectomorph and endomorphs (Lerner & Korn 1972; Staffieri, 1967) but, to our knowledge, there are no recent or media-specific studies, and thus the current paper seeks to address this gap.

Whilst a review by Klump et al. (2013) suggests the developmental work on boys is minimal and somewhat inconsistent, authors do argue that pubertal development could be associated with *both* positive and negative body image in boys. For example, and as previously noted in Chapter 1, as boy's progress through adolescence, most will be capable of moving closer to achieving the idealised muscular body shape that they desire and therefore puberty could be a positive experience for some boys in relation to their body satisfaction. However, because Western media's depicts male media figures who often possess *unrealistic*, and often *unattainable*, levels of muscularity, even with the onset of puberty, most boys would struggle to achieve such a physique themselves. Boys and young men are likely to engage in social comparison during adolescence, including with these unrealistically muscular male figures that are presented in Western media. This exposure and comparison could subsequently decrease boys' feelings of body satisfaction, and could enhance their body image disturbances, that is to negatively distort perceptions of their own body (Jones, 2001; Aubrey, 2006; Ricciardelli & McCabe, 2001a; Schooler & Ward, 2006; Hargreaves & Tiggemann, 2009; Agliata & Tantleff-Dunn, 2004). Furthermore, boys may experience increased body dissatisfaction as they move through puberty because adolescence is a time at which boys would typically start seeking out romantic partners and so, during this time, many feel increased pressure to achieve a muscular physique as a means to look stronger and more attractive to girls (Ricciardelli, et al., 2007a). Based on this evidence, and in line with the current body image literature with young girls, it is likely most boys will *also* show more pronounced signs of body dissatisfaction as they move through adolescence (Calzo et al., 2012). Indeed, Tod, Edwards and Cranswick (2016) found that muscle dysmorphia symptoms in boys is strongest during late adolescence, with the average age of onset at 18.67 years old.

It seems that as young boys develop, the pressure to achieve a muscular physique gradually increases and this is accompanied by an increased level of body dissatisfaction and image disturbance, with many young boys experiencing low self-esteem based on their non-muscular appearance (Cafri, Strauss & Thompson, 2002) and puberty in males predicting the use of food supplements and strategies to increase muscle tone (McCabe, Ricciardelli, & Banfield, 2001). The existing literature therefore demonstrates that negative body cognitions appear to increase with development and so one would expect boys to become more preoccupied with muscularity as they move through puberty. However, the literature discussed so far does not tell us much about how visual diet/ Western media consumption may affect body ideals throughout development.

4.1.2. The influence of Western media

Whilst very young children may not necessarily be exposed to the same media content as adolescent and adult male populations, the media they are exposed to is still largely dominated by unrealistic standards of Western body ideals. For example, with regards to children's popular animated film characters, female characters are often unrealistically slim and male characters unrealistically muscular (González et al., 2020) and, similarly, male toy action figures often possess largely unattainable, muscular physiques (Pope Jr et al., 1999; Boyd & Murnen, 2017) and Barbie dolls have unrealistically slim waists (Norton et al., 1996; Boothroyd, Tovée & Evans, 2021).

Further, young children, like adults, are not immune to the negative effects of such idealised bodies presented in Western media. For girls, playing appearance-focused internet games increases body dissatisfaction in those as young as 8-years-old (Slater et al., 2017), and television viewing amongst pre-adolescent girls predicts an increase in disordered eating (Harrison & Hefner, 2006; Moriarty & Harrison, 2008). Equivalent work on boys and the muscular male body ideal is somewhat neglected in comparison, though, sport magazine consumption appears to increase personal mesomorphic standards in boys as young as 10 (Rousseau, Aubrey & Eggermont, 2020). Overall, as with adults, most existing literature has primarily focused upon the effects of idealised *female* body media imagery on *girls* and, as such, both impacts of media on boys and the impacts of the muscular male body ideal specifically, have been a neglected area of study in comparison.

4.1.3. Experimental manipulation of body type preferences

As noted in previous chapters, experimental exposure to high muscle mass male bodies (e.g., Brooks et al., 2020a; Sturman et al., 2017) and thin bodies (e.g., Winkler & Rhodes, 2005; Challinor et al., 2017; Boothroyd, Tovée & Pollet, 2012) can affect perceptions of that particular idealised body type. Such work is typically carried out with adults, although Anzures and Mondloch (2009) demonstrated *face visual diet* effects in children as young as eight and Batish et al.'s (2019) pre-print paper showed similar BMI effects in 11-25-year-olds. Batish et al. (2019) found that children as young as 11 were just as prone to adaptation effects in the BMI dimension as 25-year-olds, with no evidence for developmental variation between 11 and 25 years. They concluded that body selective regions of the brain, whilst still developing at 11 years of age, may be sufficiently developed enough to show adult like performance in a low versus high adiposity adaptation experiment. However, this study did not explore perceptual changes in the muscularity dimension, despite the observation that the neural mechanisms involved in body fat and muscle perception are entirely independent of one another (Sturman et al., 2017). More generally, the literature examining manipulation of body perceptions in young children is a neglected area of work, especially with regards to manipulation of perceptions of male muscularity. Manipulation image exposure and its contributions to musculature preference/body ideal shifts in children is thus ripe for investigation.

4.1.4. Aims

The current paper describes associations between age and i) internalisation of cultural body ideals and pressure to achieve such ideals (as measured by the Sociocultural Attitudes Towards Appearance Questionnaire 4; SATAQ-4), and ii) one's drive for muscularity (as measured by the Drive for Muscularity Scale; DMS) (Study 5). Furthermore, it examines associations between age and one's baseline muscularity preferences, as well as whether muscularity preference manipulation can be observed in children aged 6-18-years-old, and whether age and/or any body attitudinal and/or behavioural factors (e.g., SATAQ-4 and/or DMS scores) can predict susceptibilities to any such perceptual visual diet effects (Study 6) as has been the case with previous work using adult samples (e.g., Glauert et al., 2009; Stephen et al., 2018, although cf. Boothroyd, Tovée & Pollet, 2012).

Finally, as an exploratory part of this paper, we examined whether age, gender, and internalisation of cultural body ideals, pressure to achieve such ideals and/or one's drive for muscularity could affect the words children use to describe muscular (non-muscular) bodies (Study 7).

4.1.5. Description of study samples

The three studies described in this paper were carried out with three samples, with each sample participating in some or all components of those studies as detailed within the individual method sections. Sample 1 consisted of 204 (102 male and 102 female) 11-18-year-old participants recruited from the secondary section of a private grammar school in the North of England who were tested in a school computer room during their form period. They completed the Study 5 measures, before the Study 6 muscularity preference manipulation task and then finally the media description task as described in Study 7. Sample 2 consisted of 101 (52 male and 49 female) 6-11-year-old participants recruited through Durham University's 'Junior Scientist event' (a 2-day event where children attended with their parents to complete multiple studies for rewards) and through snowball sampling. These participants were tested in a room on a laptop with the researcher present. They completed Study 6 followed by Study 7. Sample 3 consisted of 89 boys aged 8-14-years-old recruited from a same-sex private school in the North-West of England who were tested in a school computer room during their form period. They completed a revised version of the SATAQ-4 questionnaire (see supplementary materials), before completing the rest of Study 6 and 7 in order. A breakdown of participant age and gender across the three samples is presented in the Study 6 section of this chapter (Table 4.3).

4.2. Study 5: Effect of age on internalisation of cultural body ideals and attitude to muscularity.

As previously summarised, the existing developmental work suggests that children's body image issues are likely to peak as they move through adolescence. Though, there has been limited work on boys, and preoccupation with muscularity. Study 5 therefore sought to explore the following hypothesis: H1: ***There will be a significant positive relationship between age and internalisation of cultural body ideals and one's drive for muscularity.***

4.2.1. Method

4.2.1.1. Ethics

Ethical approval for all studies was gained from Durham University's Psychology Department Ethics Committee. Once written parental consent had been gained, student participants were asked to provide their own consent before the trials began by clicking a box to confirm they had read and understood the information sheet. Participants were shown the debrief statement once they had completed all trials and were provided with a web link to a popular body image support website.

4.2.1.2. Participants

Study 5 involved Sample 1 which was made up of 204 (102 male and 102 female) participants aged 11-18-years-old (see Table 4.3 for sample detail).

4.2.1.3. Measures and procedures

Attitudes to appearance: After providing their age, year group, and gender, participants completed the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4) (Thompson et al., 2011) as described in Chapter 1 and in the previous empirical chapters of this thesis.

Attitudes to muscularity: Participants then completed the Drive for Muscularity Scale (DMS) (McCreary, 2007), which is, again, described in Chapter 1 and in the previous empirical chapters of this thesis.

4.2.2. Results and interim discussion

The central aim of Study 5 was to explore the relationship between age and internalisation of muscular body ideals (SATAQ-4 Internalisation-Muscular subscale scores) and drive for muscularity (DMS scores) in a sample of adolescents.

Summary statistics for each measure and correlation coefficients overall and within gender are presented in Table 4.1. Correlational analyses revealed a significant positive relationship between age and Internalisation-Muscular SATAQ-4 subscale scores for both boys ($r=.46$, $N=98$, $p<.001$) and girls ($r=.27$, $N=101$, $p=.003$). Further, there was a significant positive relationship between age and total DMS score for boys ($r=.62$, $N=96$, $p<.001$) but not girls ($r=.17$, $N=98$, $p=.09$). Visual displays of these relationships are presented in Figure 4.1 and further correlational analyses involving all other SATAQ-4 subscales are presented in Appendix B.1.

Table 4. 1

Means, standard deviations and correlations for *age, Internalisation-Muscular SATAQ-4 subscale score (Int-Musc SATAQ) and Drive for Muscularity (DMS) score.*

Data overall	M	SD	Min	Max	1	2
1. Age	14.72	2.22	11	18		
2. DMS	2.20	0.97	1	6	.38*	
3. Int-Musc SATAQ	32.99	14.58	15	90	.37*	.61**
Boys	M	SD			1	2
1. Age	14.69	2.22	11	18		
2. DMS	2.55	0.99	1	5.07	.62**	
3. Int-Musc SATAQ	38.28	14.80	15	76	.46**	.78**
Girls	M	SD			1	2
1. Age	14.75	2.23	11	18		
2. DMS	1.85	.827	1	6	.17	
3. Int-Musc SATAQ	27.81	12.40	15	90	.27**	.40**

*Note: Five participants did not complete the SATAQ-4 items in full and ten participants did not complete the DMS items in full; these participants' data were excluded for the relevant score. M and SD are used to represent mean and standard deviation, respectively. *p<.05, **p<.01.*

Regression analyses confirmed that age significantly predicted SATAQ-4 Internalisation-Muscularity scores (*p*<.01) and DMS scores (*p*<.01) and did so differently in boys and girls. Figure 4.1 shows these relationships and full regression statistics are presented in Table 4.2 below. Further regression models for all other SATAQ-4 subscale scores are presented in Appendix B.2 and these show that there were no further gender differences in how age predicts all other SATAQ-4 subscale measures, which is unsurprising given that muscularity is thought to be a key aspect of *male* body image specifically.

Overall, Study 5 findings are in line with the existing literature that suggests young boys (Calzo et al., 2012) and girls (Ricciardelli & McCabe, 2001b; Thompson & Chad, 2000; Calzo, et al., 2012) show more preoccupation with cultural body ideals as they move through adolescence, with the average age of onset for muscle dysmorphia symptoms peaking at 18-years-old (Tod, Edwards & Cranswick, 2016) and the average age of anorexia nervosa and bulimia nervosa onset at 18-years-old (Volpe et al., 2016). The fact that drive for muscularity only increased with age in boys is unsurprising given that muscularity is a key aspect of male body image specifically in Western culture.

Table 4. 2

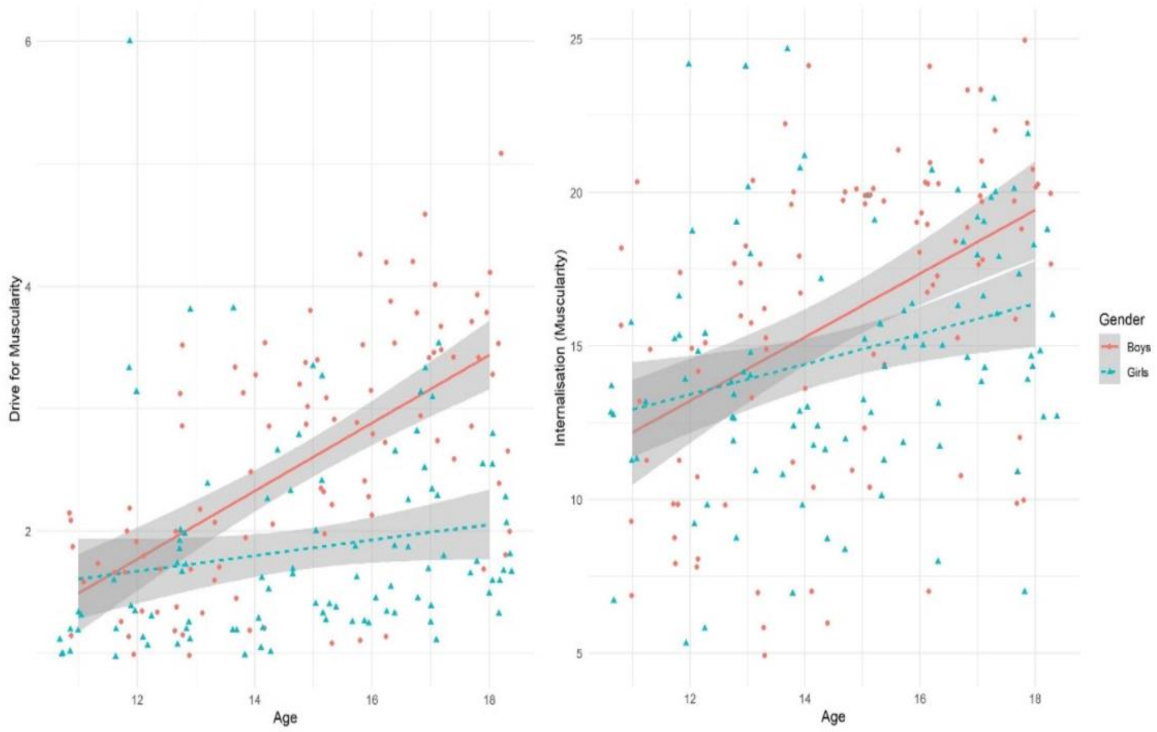
Regression table for age, gender and both DMS and Internalisation-Muscular (Int-Musc) SATAQ-4 subscale scores.

	DMS	Int-Musc
Age	0.171** (0.026)	0.764**(0.134)
Gender	-0.634**(0.116)	-1.152 (0.597)
Age:Gender	-0.214** (0.052)	-0.544*(0.268)
Constant	2.151** (0.058)	15.224**(0.298)
Observations	194	199
R2	0.333	0.171
Adjusted R2	0.323	0.158
Residual Std. Error	0.800 (df = 190)	4.187 (df = 195)
F Statistic	31.640** (df = 3; 190)	13.373** (df = 3; 195)

*Note: Five participants did not complete the SATAQ-4 items in full and ten participants did not complete the DMS items in full; these participants' data were excluded for the relevant score. Standard errors are presented in parentheses.*p<.05, **p<.01.*

Figure 4. 1

Scatterplots to show the relationship between i) age and SATAQ-4 scores (left) and ii) age and DMS scores (right), with grey 95% confidence intervals.



4.3. Study 6: Muscularity preferences and manipulation of such preferences in children aged 6-18-years-old.

As previously discussed, a key hypothesis in body image research is that visual media may be driving internalisation of restricted body ideals. It is well established that short term visual exposure can modulate adults' preferences for body size/shape, but this largely concerns female weight (e.g., Glauert et al., 2009). Furthermore, besides one pre-print (Batish et al., 2019), we are not aware of any work exploring lab-based visual diet effect perceptual changes in children. In an attempt to address this gap, Study 6 measured preferences for muscularity in male stimuli and tested musculature visual diet effects in 6-18-year-olds, looking at whether age modulates the impact of visual exposure on preferences. For those students who provided DMS and/or SATAQ-4 responses, we also explored whether such factors that can be associated with one's body image could predict the strength of any visual diet effects as has been the case with previous work with adult samples (e.g., Glauert et al., 2009; Stephen et al., 2018, although cf. Boothroyd, Tovée & Pollet, 2012). For Study 6, it was hypothesised that: ***H2: There will be a significant positive relationship between age and baseline preference for muscularity, and H3: Viewing high (low) muscle mass male bodies will increase (decrease) muscularity preferences and this will be modulated by age and/or internalisation of muscular body ideals and/or drive for muscularity.***

4.3.1. Method

4.3.1.1. Participants

Sample 1, 2 and 3 (Total N=394) all completed a muscularity preference and manipulation task. A breakdown of participant age and gender across the three samples is presented in Table 4.3.

4.3.1.2. Measures and procedures

Attitudes towards appearance and muscularity: All participants first provided their age, year group and gender. Sample 1 had already provided SATAQ-4 and DMS responses in Study 5, which were also used in Study 6 analyses. Due to ethical requirements of the Junior Scientist Event, participants in Sample 2 did not complete the SATAQ-4 or DMS questionnaires. Sample 3 completed a revised version of the SATAQ-4 questionnaire (see Appendix C) which was amended to aid comprehension in younger participants (e.g., ‘It is important for me to look athletic’ was revised to: ‘It is important for my body to look strong and like I do a lot of sport.’).

Table 4. 3

Summary of age sliced N values for each condition for each of the 3 samples.

Sample 1

Age	Condition 1 (high muscle mass)		Condition 2 (low muscle mass)		Total
	Males	Females	Males	Females	
11	4	5	4	3	16
12	7	6	6	6	25
13	5	8	10	6	29
14	6	7	6	7	26
15	6	7	7	6	26
16	8	6	7	5	26
17	6	6	6	10	28
18	7	8	7	6	28
Total	49	53	53	49	204

Sample 2

Age	Condition 1 (high muscle mass)		Condition 2 (low muscle mass)		Total
	Males	Females	Males	Females	
6	5	5	6	5	21
7	4	6	4	5	19
8	4	4	5	4	17
9	6	4	7	4	21
10	4	6	4	5	19
11	1	0	2	1	4
Total	24	25	28	24	101

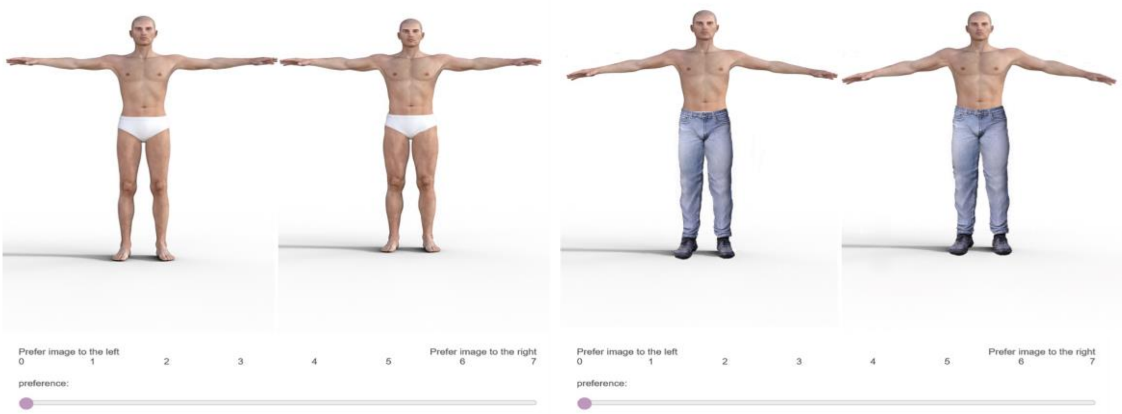
Sample 3

Age	Condition 1 (high muscle mass)		Condition 2 (low muscle mass)		Total
	Males	Females	Males	Females	
8	0	0	2	0	2
9	2	0	1	0	3
10	5	0	4	0	9
11	5	0	5	0	10
12	11	0	7	0	18
13	14	0	18	0	32
14	9	0	6	0	15
Total	46	0	43	0	89

Preference for muscularity: All participants then completed an initial preference for muscularity task in which they viewed 6 pairs of CGI images of male bodies, where within each pair, one image was of a higher and one of a lower muscle mass male. Participants were asked to indicate which image from each pair they preferred and the extent to which they preferred it using an 8-point slider scale from '0- strongly prefer left body' to '7- strongly prefer right body', with the more muscular body presented to the right hand side for half of all trials and the left hand side for the remaining trials in a randomised order. Stimuli were based on those used by Jacques, Evans, and Boothroyd (2021). Sample 1 (11-18-year-old boys and girls) viewed these stimuli in original form, but due to ethical requirements for younger participants, Samples 2 (6-11-year-old girls and boys) and 3 (8-14-year-old boys) viewed edited versions wearing trousers. Arms were also lowered slightly such that the posture of the males used as stimuli appeared more natural (see Figure 4.2).

Figure 4. 2

Example trial from the muscularity preference task for Sample 1 (left) and 2 and 3 (right).



Muscularity preference scores were generated by averaging the scores for each of the 6 preference trials. A high average score indicated a preference for high muscle mass male bodies whilst a low score indicated a preference for low muscle mass male bodies.

Manipulation phase task: Participants then completed the manipulation phase of the study. They were told that this phase of the study was designed to further explore body preferences. They were shown a series of images (presented individually) and, to ensure visual engagement, were asked to compare each new image presented to the image previously seen whilst indicating which one they found the most attractive (for the first manipulation phase image presented, participants were asked to compare it to the last viewed pre-manipulation preference phase image). Participants were randomly allocated to view 48 images of high muscle mass males, or 48 images of low muscle mass males.

Sample 1 (11-18-year-old boys and girls) viewed 24 CGI images and 24 photos of high (condition 1) or low (condition 2) muscle mass bodies. The CGI images were based on the preference task stimuli, while the photographs were open access images of naked men (genitals and faces obscured) retrieved from Morrison et al. (2017). These photographs were as per Jacques et al (2021, conditions 3 & 4). Due to the ethical requirements for younger participants, Samples 2 (6-11-year-old boys and girls) and 3 (8-14-year-old boys) were shown photographs of either high, or low, muscle mass males from male clothing websites (e.g., Father Sons Clothing and Fred Perry; previously used by Jacques et al, 2021, conditions 1 and 2).

Following the manipulation phase of the study, participants from all samples were asked to complete the preference for muscularity task again to assess whether their preference for muscularity had changed following the manipulation phase.

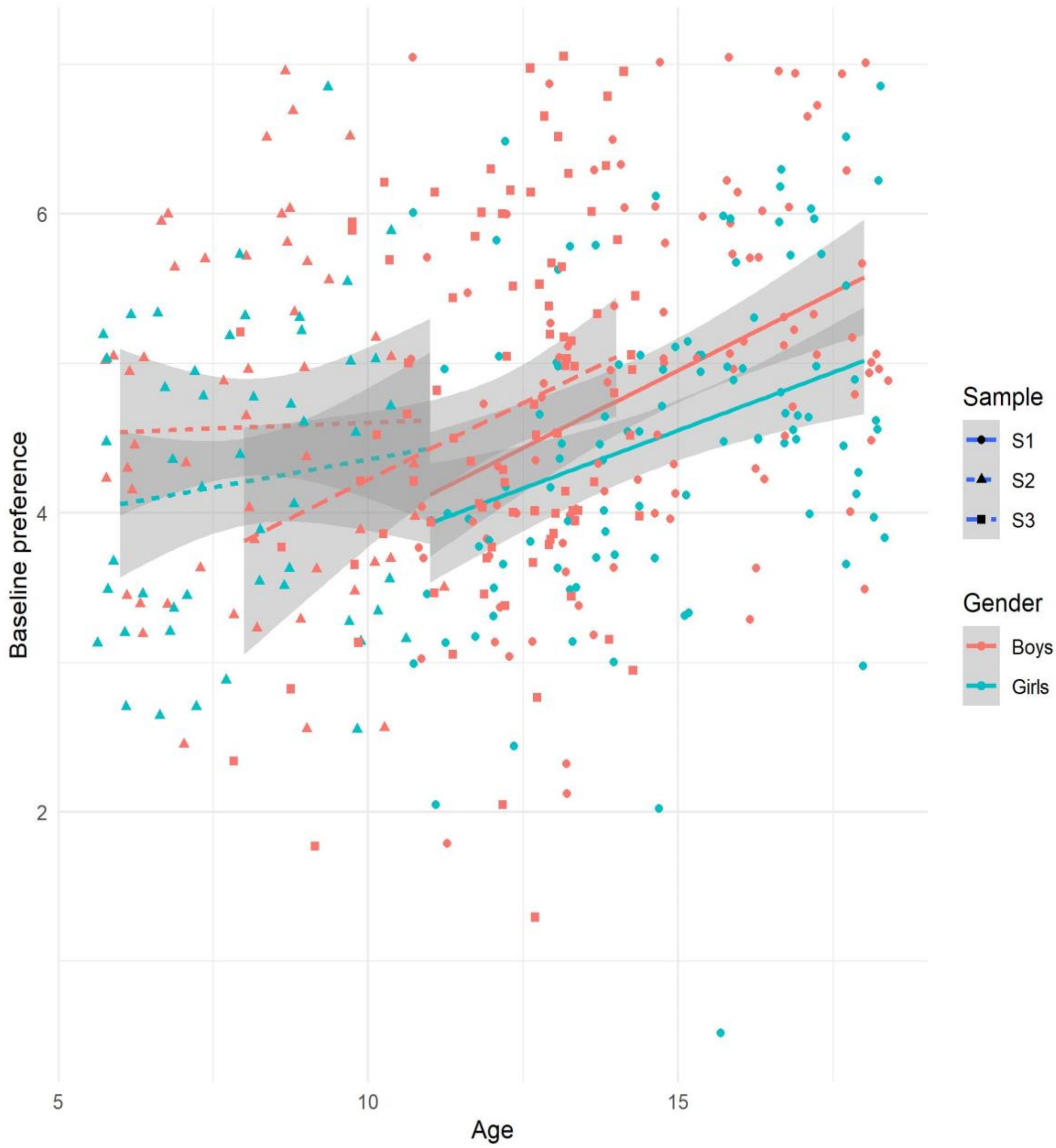
4.3.2. Results

4.3.2.1. Does age predict baseline preference for muscularity?

For the 11-18-year-olds in Sample 1, there was a positive correlation between age and baseline preference for muscularity scores (r=.35, N=204, p<.001) and this relationship held when both male (r=.39, N=102, p<.001) and female data (r=.32, N=102, p<.001) were analysed separately. Appendix B.1 provides details of the relationships between preferences for muscularity, age, total SATAQ score, DMS score, and each of the 5 SATAQ-4 subscales for Sample 1. For the 6-11-year-olds making up Sample 2, there was no relationship between age and baseline preference for muscularity (r=.07, N=101, p=.501). This lack of relationship held when both the male data (r=.029, N=52, p=.840) and female data (r=.113, N=49, p=.438) were analysed separately. However, for the 8-14-year-old boys in Sample 3, there was a significant positive relationship between age and baseline preference for muscularity (r=.248, N=89, p=.01), though this sample was made up of predominantly 12-14-year-old boys and so age-slices were not similarly weighted here (see Table 4.3). Relationships between age and preferences for muscularity for all three samples are presented in Figure 4.3 below.

Figure 4. 3

Scatterplot showing the relationship between age and baseline muscularity preference for boys and girls in Samples 1 (11-18-year-old boys and girls), 2 (6-11-year-old boys and girls) and 3 (8-14-year-old boys). Grey areas represent 95% confidence intervals.



4.3.2.2. Does exposure to high or low muscle mass male images increase/decrease preferences for muscularity and does age and/or internalisation of muscular body ideals/ body image disturbance influence susceptibility to such visual diet effects?

4.3.2.2.1. Evidence for visual diet effects in the muscularity dimension in childhood and adolescent groups:

A mixed ANOVA on all data, where test phase (pre- versus post-manipulation) was a repeated measures variable, and condition (high muscle mass or low muscle mass) was a between participants factor, revealed a significant interaction between phase and condition ($F_{1,392}$= 6.437, p=0.011, partial eta^2=.016) such that preferences for muscularity, on average, decreased following exposure to low muscle mass manipulation images and increased following exposure to high muscle mass males. This interaction is presented in Table 4.4 (Model 1).

A post-hoc paired-samples t-test revealed a significant difference between mean pre- and post-manipulation muscularity preference scores for those viewing high muscle mass images in condition 1 (t(196) = -2.243, p= .02) but no such significant difference for those viewing low muscle mass images in condition 2 (t(196) = 1.333, p = .184).

Table 4. 4

Tabulated values for mixed ANOVA with phase (pre- versus post- manipulation preference for muscularity scores) as the repeated measures variable and condition (condition 1 versus condition 2) as the between participants factor (Model 1), with gender and age added to the model (Model 2). Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Model 1				
Phase	1, 392	.639	.425	.002
Condition	1, 392	.001	.975	.000
Phase * Condition	**1, 392**	**6.473**	**.011***	**.016**
Model 2				
Phase	1,386	.916	.916	.002
Condition	1,386	.266	.607	.001
Gender	1,386	.053	.817	.000
Age	1,386	29.930	.000**	.072
Condition*Gender	1,386	2.207	.138	.006
Condition*Age	1,386	.358	.550	.001
Gender*Age	1,386	.343	.558	.001
Condition*Gender*Age	1,386	2.395	.123	.006
Phase*Condition	**1,386**	**.327**	**.568**	**.001**
Phase*Gender	1,386	.065	.799	.000
Phase*Age	1,386	1.357	.245	.004
Phase*Condition*Gender	1,386	8.294	.004**	.021
Phase*Condition*Age	1,386	1.929	.166	.005
Phase*Gender*Age	1,386	.086	.769	.000
Phase*Condition*Gender*Age	**1,386**	**6.825**	**.009****	**.017**

**p*<.05, ***p*<.01.*

4.3.2.2.2. Age and susceptibility to visual diet effects in the muscularity dimension

There was a significant interaction between phase, condition, gender and age ($F_{1,386}$= 6.825, p=.009, partial eta^2=.017) as presented in Model 2 within Table 4.4. To further investigate this interaction, data was split by gender and analyses revealed a significant interaction between phase, condition and age for boys ($F_{1,239}$=10.252, p=.002, partial eta^2=.041), but not girls ($F_{1,147}$=.552, p=.459, partial eta^2=.004).

Much of the pre-existing childhood and adolescent body literature has dichotomised age into an 11-14-year-old age group category and a 15-18-year-old one (e.g., Dally, 1977; Smithers et al., 2000; Matthiessen et al., 2008; Christian et al., 2020), with Christian et al. (2020) proposing that these age categories represent unique developmental stages in terms of one's physiological and neurological development, maturity, and autonomy. In keeping with this literature, and to investigate the effect of age further, we too split participants into an 11-14 and 15–18-year-old category, as well as creating a 6-10-year-old age category. When data was split into these three age categories, analyses revealed a significant interaction between phase and condition for the older 15-18-year-old boys ($F_{1,52}$=13.185, p=.001, partial eta^2=.202), but not girls ($F_{1,52}$=1.205, p=.277, partial eta^2=.023). Further, no significant interactions between phase and condition were found for the 11-14-year-old boys ($F_{1,124}$=.316, p=.575, partial eta^2=.003) or girls ($F_{1,47}$=.996, p=.323, partial eta^2=.021), nor for the 6-10-year-old boys ($F_{1,61}$=1.084, p=.302, partial eta^2=.017) or girls ($F_{1,46}$=3.980, p=.052, partial eta^2=.023). A post-hoc paired-samples t-test revealed a significant difference between mean pre- and post-manipulation muscularity preference scores for those 15-18-year old boys viewing high muscle mass images (t(26) = -2.896, p= .008) and for those viewing low muscle mass images (t(26) = 2.352, p =.027) such that viewing high/low muscle mass images significantly increased/decreased preferences for muscularity, respectively, in boys of this age group. Overall, analyses show that it is older boys (15-18-year-olds specifically) who are more susceptible to visual diet effects over younger boys (14-years-old and younger) and there are no such age effects in the girls making up the samples. Figure 4.4 below provides a visual display of the average changes in muscularity preferences post-manipulation phase for each of the dichotomised age categories split by gender, and Figure 4.5 depicts the changes in preferences for those older children of Sample 1 specifically.

Figure 4. 4

Violin and box plots showing the muscularity preferences for boys and girls at pre- (Time 1) and post- (Time 2) manipulation phase for high muscularity (red) and low muscularity (blue) conditions for each of the dichotomised age groups (Top: Under 11-years-old, Middle:11-14-years-old and Bottom: 15-18-years-old).

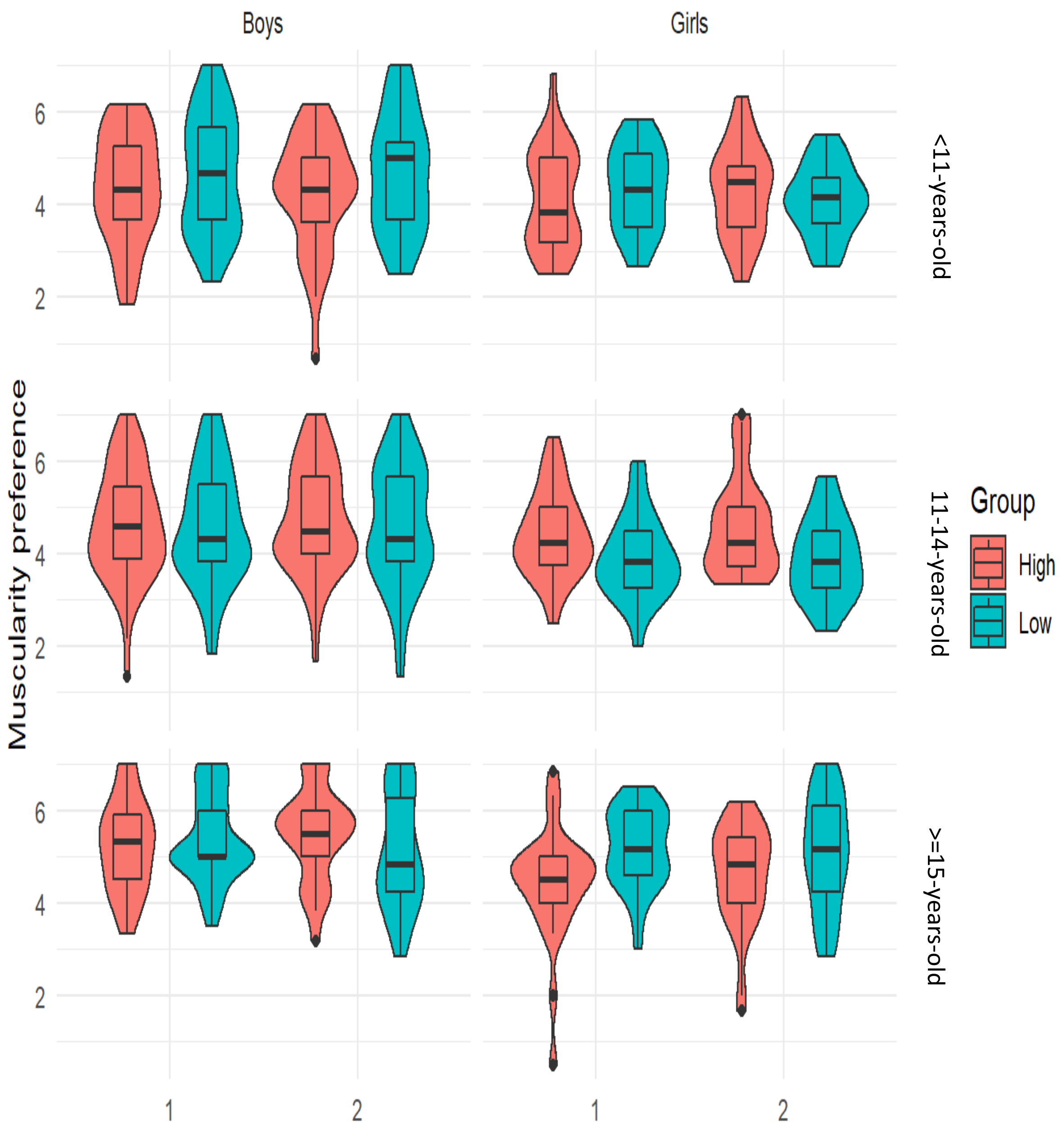


Figure 4. 5

Scatterplot, with male data to the left and female data to the right, to show the relationship between age and change in preference for muscularity following exposure to either high or low muscle mass manipulation images for Sample 1, where Y axis 0 represents no change in preference for muscularity. Grey areas represent the 95% confidence intervals.

4.3.2.2.3. Internalisation of body ideals, body image disturbance and susceptibility to visual diet effects in the muscularity dimension

Given that 15-18-year-old boys were the only age group to show a significant interaction between phase and condition, we explored whether Internalisation-Muscular SATAQ-4 subscale scores and/or DMS scores moderated the visual diet effects in this group. Here, there was no significant interaction between phase, condition and Internalisation-Muscular subscale SATAQ-4 scores ($F_{1,48}$= 1.431, p=.237, partial eta^2=.029) as presented in Table 4.5 (Model 1), nor such a three-way interaction involving total DMS score ($F_{1,49}$= .418, p=.521, partial eta^2=.008) as presented in Table 4.5 (Model 2), nor for DMS when it was split into the attitudinal ($F_{1,49}$= .226, p=.637, partial eta^2=.005) or behavioural ($F_{1,149}$= .442, p=.509, partial eta^2=.009) components.

Table 4. 5

Tabulated values for mixed ANOVA with phase (pre- versus post- manipulation preference for muscularity scores) as the repeated measures variable and condition (condition 1 versus condition 2) as the between subjects factor (Model 1), with Internalisation-Muscular (Int-Musc) and DMS scores added to the model as covariates (Model 2). Critical tests of our hypotheses are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Model 1				
Phase	1,48	.006	.939	.000
Condition	1,48	.120	.731	.002
Int-Musc	1,48	14.041	.000**	.226
Condition*Int-Musc	1,48	.249	.620	.005
Phase * Condition	**1,48**	**.205**	**.653**	**.004**
Phase*Int-Musc	1,48	.008	.930	.000
Phase*Condition*Int-Musc	**1,48**	**1.431**	**.237**	**.029**
Model 2				
Phase	1,49	.006	.937	.000
Condition	1,49	.068	.795	.001
DMS	1,49	35.929	.000**	.423
Condition*DMS	1,49	.035	.852	.001
Phase * Condition	**1,49**	**2.414**	**.127**	**.047**
Phase*DMS	1,49	.002	.967	.000
Phase*Condition*DMS	**1,49**	**.418**	**.521**	**.008**

$^*p<.05$, $^{**}p<.01$.

4.3.3. Interim discussion

The purpose of Study 6 was to explore muscularity preferences and manipulation of male musculature preferences in 6-11-year-old school students. In terms of baseline muscularity preferences, analysis of the data provided by the 11-18-year-olds in Sample 1 and the 8-14-year-olds in Sample 3 revealed a significant positive relationship between age and baseline preferences for muscularity in that there appears to be a steady increase in one's preference for muscularity (pre-manipulation preference score), a relationship that held for both boys and girls. There was no significant relationship between age and baseline preferences for muscularity amongst the 6-11-year-olds making up Sample 2, however. Such a relationship may not be apparent with younger children as it could be that children only start to become preoccupied with male muscularity around 11 years of age. Indeed, findings are in line with the current literature that suggests young boys become more preoccupied with muscularity and show more pronounced signs of body image disturbances as they move through adolescence (Calzo et al, 2012), with the average age of onset for muscle dysmorphia symptoms peaking at 18 years old (Tod, Edwards, & Cranswick, 2016). Nevertheless, it is crucial that future work seeks to replicate Study 6 to further ascertain whether such a relationship does, or does not, exist in very young children.

Another central aim of Study 6 was related to manipulation of musculature preferences. Specifically, it aimed to explore whether viewing high/low muscle mass male images could increase/decrease preferences for muscularity in children and adolescent groups, as well as whether age and/or internalisation of muscular body ideals, pressure to achieve such ideals and/or a drive for muscularity modulates the strength of any such effects. Findings revealed that viewing high muscle mass male bodies increased one's later preferences for muscularity, although it was only older boys (those aged 15-18-years old) who showed this effect when data was broken down by gender and age. Social comparison processes (Festinger, 1954) could explain the gender difference here, given that one of its central assumptions is that we spend a lot of time attending to stimuli that we identify with. As Study 6 stimuli were made up of *male* body stimuli, Social Comparison Theory would predict that male participants (over female participants) would spend a longer time attending to such images, comparing themselves to them, thus explaining why visual diet effects were more pronounced for boys over girls here.

An alternative explanation is that, as discussed in relation to Study 5, boys may become more preoccupied with muscularity as they get older. Thus, with greater preoccupation, older boys may pay more attention to muscularity of the men depicted in the manipulation imagery and this therefore may explain why muscularity visual diet effects are more prevalent in this group specifically. One approach to testing this is to consider the moderation analysis in regards to muscular internalisation and drive for muscularity.

Given that 15-18-year-old boys were the only age group that experienced significant shifts in their preferences for muscularity following manipulation image viewing, we explored whether high Internalisation-Muscular SATAQ-4 subscale scores and/or high DMS scores moderated such visual diet effects in this group. Here, Study 6 findings showed no moderating effects. Thus, data overall show that as boys age, their preferences appear to be more malleable in response to their visual diets, but this is *not* likely due to increasing internalisation of the muscular body ideals and/or their baseline body image disturbances.

As discussed previously, another neglected area of research related to muscularity preferences in childhood and adolescence is that of young children's perceptual judgments of high and low muscularity. Whilst Study 5 and 6 suggest that as children get older, their preferences for muscularity and internalisation of muscular body ideals increase, these findings do not tell us whether there are any differences in how a child reports to perceive high (low) muscle mass images. As such, Study 7 was designed as an exploratory study that sought to further examine perceptions of muscularity in 6-18-year-olds by asking participants from all three samples to provide free-text descriptions of high and low muscle mass males from the media. Study 7 explores whether there are any differences in descriptions of high (low) muscle mass males across the different age groups, between boys and girls, and between those who possess high and low Internalisation-Muscularity SATAQ-4 subscale and DMS scores.

4.4. Study 7: Media description task.

As previously noted, studies from the 1960s and 70s have shown that boys as young as five and six assign favourable adjectives to low-quality mesomorph male body silhouettes and unfavourable adjectives to ectomorph and endomorphs (Lerner & Korn 1972; Staffieri, 1967) but, to our knowledge, there are no recent or media-specific studies, and thus the current paper seeks to address this gap. Study 7 therefore set out to explore the following hypothesis: H4: ***There will be differences in the adjectives a child or adolescent uses to describe high versus low muscle mass male body media imagery.***

4.4.1. Method

4.4.1.1. Participants

Sample 1, 2 and 3 all completed the media description task following their musculature preference manipulation tasks. A breakdown of participant age and gender across the three samples is presented in Table 4.3.

4.4.1.2. Procedure

Participants were shown 3 high muscle mass and 3 low muscle mass photographs of attractive males in high status clothing from clothing websites (e.g., Father Sons Clothing and Fred Perry). The 6 images were presented in a randomised order and participants were asked for each image: 'What do you think this person is like based on their photo alone?'. They responded with free text. An example trial is presented in Figure 4.6 below.

Figure 4. 6

Example trial from the 'Media Image Description' phase of the study.

4.4.2. Results

4.4.2.1. Are there differences in the types of adjectives a child or adolescent uses to describe media images of either high or low muscle mass?

A content analysis was carried out on all qualitative data from the media description task completed by each of the three samples. Twenty category themes representing the most frequently referred to descriptions of the two image types (high versus low muscle mass males) were identified (see Appendices D.1-D.6). Two independent raters coded the qualitative responses according to these

20 themes. Cohen's K was run to determine the agreement between each of the two raters' judgments. There was high agreement for Sample 1: k=.962 (95% CI, .9326 to .9914), *p*<.001, Sample 2: k=.945 (95% CI, .931 to .959), *p*<.001, and Sample 3: k=.972 (95% CI, .964 to .980), *p*<.001. The top three most frequently occurring themes for high and low muscle mass images for each of the three samples are presented in Table 4.6 below. Further details of the frequency at which each category theme was referred to for each image type for each of the three samples, which are also divided by gender (for Sample 1 and 2), age categories (11-14 versus 15-18-years old), by high and low mean-split Internalisation-Muscular SATAQ-4 scores (Sample 1 and 3), and mean-split DMS scores (for Sample 1) can be found in the supplementary materials of this paper (Appendices D.1-D.8).

Table 4. 6

The three most frequently occurring themes for high and low muscle mass images for each sample, with example free-text descriptions in parentheses.

High muscle mass images			Low muscle mass images		
Sample 1 (11-18-year-old boys and girls)	Sample 2 (6-11-year-old boys and girls)	Sample 3 (8-14-year-old boys)	Sample 1 (11-18-year-old boys and girls)	Sample 2 (6-11-year-old boys and girls)	Sample 3 (8-14-year-old boys)
1. High Athleticism/ Muscularity *(e.g., 'Athletic')*	1. High Athleticism/ Muscularity *(e.g., 'Strong')*	1. High Athleticism/ Muscularity *(e.g., 'Goes to the gym a lot')*	1. High Approachability *(e.g., 'Kind. Nice person')*	1. High Approachability *(e.g., 'Kind')*	1. Low Athleticism/ Muscularity *(e.g., 'Skinny')*
2. Arrogance and Related Traits *(e.g., 'Boastful')*	2. Irritating, Undesirable Traits *(e.g., 'Annoying')*	2. High Approachability *(e.g., 'Kind'*)	2. Low Athleticism/ Muscularity *(e.g., 'Quite skinny')*	2.High Intelligence *(e.g., 'Clever and loves learning')*	2. High Intelligence *(e.g., 'Intelligent')*
3. High Confidence/ Extraversion *(e.g., 'Confident')*	3. Aggressive Intimidating Traits *(e.g., 'Angry')*	3.Determination *(e.g., 'Hard-working')*	3. High Intelligence *(e.g., 'High IQ')*	3. Irritating and Undesirable Traits *(e.g., 'Nosey')*	3. High Approachability *(e.g., 'Friendly')*

Note: This table presents an overview of the most frequently occurring category themes when 'No response Provided' and the 'Other' categories are excluded.

Key findings include that for all three samples, adjectives assigned to high muscle mass images were mostly in reference to the model's 'high athleticism/muscularity' suggesting that most children (aged 6-18-years-old) notice model muscularity and choose to refer to this feature, above all other features/perceptions, when asked to make free-text perceptual judgements of such images.

Participants making up Sample 1 and 3 shared the same top three description themes for low muscle mass images which were ‘low athleticism/muscularity’, ‘high intelligence’ and ‘high approachability’. Sample 2 participants also commonly referred to ‘high approachability’ and ‘high intelligence’ of the low muscle mass images, but they also frequently referred to ‘irritating undesirable traits’, rather than making reference to the models’ ‘low athleticism/muscularity suggesting that 6-11-year-olds may be less inclined to notice or comment on the physiques of low muscle mass men in comparison to older children. There were no other striking differences in responses when SATAQ-4 and DMS scores were mean split, nor when data was split by gender or age.

4.4.3. Interim discussion

Study 7 aimed to explore whether there were any differences in the types of adjectives a child or adolescent used to describe media images of either high or low muscle mass. There were more similarities than differences in terms of the adjectives assigned to high (low) muscle mass male media bodies across the different age groups, genders, and those with varying levels of internalisation of cultural body ideals and drive for muscularity.

Both boys and girls of all samples overwhelmingly focused on the muscularity and athleticism of the model depicted in the high muscle mass media images. For low muscle mass images, on the other hand, there was less of a focus on the model’s physique, although it was still often referred/alluded to, just to a lesser extent. They instead emphasised the model’s non-physical traits like their perceived ‘High Approachability’. Whilst there were more similarities than differences in descriptions assigned across the different groups, findings did show that younger boys and girls (6-11-year-olds) seemed less inclined, in comparison to older 11-18-year-olds, to comment on the physiques of low muscle mass males, though they still emphasised, and focused upon, physique when describing high muscle mass males. This suggests that perhaps children only start to become preoccupied with a *lack* of muscularity as they get older (post-11-years-old). Indeed, further research into this neglected field is crucial to further ascertain whether there exists an age difference here.

In terms of interpreting qualitative responses provided by girls and young women, these seem very much in line with the trade-off model (Gangestad & Simpson, 2000) which suggests masculine features like muscularity in men has both positive and negative associations. Whilst it can be a cue of strength (i.e., 'high athleticism') and dominance (i.e., 'high confidence'), it can also signal negative traits including reduced suitability as a long-term partner and reduced parental investment (i.e., 'high arrogance') (Boothroyd, Jones, Burt & Perrett, 2007).

What is particularly interesting about Study 7's findings is that despite the increases in preference for muscularity and internalisation of muscular male body ideals (in girls and boys) and drive for muscularity (in boys) as children get older (as Study 5 and 6 findings have revealed), we do not see any vast differences in terms of how participants qualitatively evaluated or described high (low) muscle mass images at different ages. This may suggest that children's conscious muscularity perceptions do not necessarily differ between age groups even if their ideals, drive for muscularity, and preferences do. As previously noted, however, this area is a neglected field of research and further work is needed to further ascertain whether findings here can be replicated.

4.4.4. Discussion

This research is the first of its kind to explore muscularity attitudes and manipulation of musculature preferences in childhood and adolescence. The three studies described in this paper explore associations between age and internalisation of cultural body ideals and drive for muscularity (Study 5), as well as associations between age and one's baseline muscularity preferences, and whether muscularity body visual diet effects can be observed in children aged 6-18-years-old (Study 6). These results were contextualised by considering how children and adolescents describe muscular versus non-muscular male media figures (Study 7).

Four main hypotheses were proposed, the first of which was: H1: ***There will be a significant positive relationship between age and both internalisation of cultural body ideals and one's drive for muscularity.*** This was tested with the sample of 11-18-year-olds where findings revealed that age does indeed correlate with muscularity body preoccupations and internalisation of cultural body ideals, such that the older boys get, the higher their DMS score becomes, and the older boys and girls get, the higher their Internalisation-Muscular SATAQ-4 subscale score becomes.

The second hypothesis, H2: ***There will be a significant positive relationship between age and baseline preference for muscularity,*** was also supported in that analyses of Samples 1 and 3 revealed a positive relationship between age and baseline preferences for muscularity in both boys and girls, though such a relationship was not apparent amongst the younger 6-11-year-olds who constituted Sample 2.

The third hypothesis was H3: ***Viewing high (low) muscle mass male bodies will increase (decrease) muscularity preferences and this will be modulated by age and/or internalisation of muscular body ideals and/or drive for muscularity.*** Findings of Study 6 suggest muscularity visual diet effects can occur in combined child and adolescent samples, but the investigation of the gender and age interaction effect shows that these effects may only become significant towards the latter part of adolescence (i.e., in 15-18-year-olds) for boys specifically. Neither Internalisation-Muscular SATAQ-4 subscale scores nor high DMS scores moderated such visual diet effects in this group.

The fourth hypothesis was: H4: ***There will be differences in the adjectives a child or adolescence uses to describe high versus low muscle mass male body media imagery.*** Findings revealed that irrespective of age, gender, Internalisation-Muscular SATAQ-4 subscale scores and DMS scores, children and adolescents describe muscular (non-muscular) bodies in very similar ways. Future work may seek to further explore muscularity perceptions with closed questions, as opposed to the free text response questions used in the current study. Such questions could include the use of Likert scale ratings to assess perception of the male in the media image's approachability, attractiveness, physical strength, and how much a participant would like to be friends with the person in the media image, for example. This would generate quantitative data which would make social perceptions of muscularity between each of the different groups statistically comparable. It would also reduce ambiguity in terms of interpreting qualitative responses; for example, in the current study several participants described one of the male media figures as 'smart' which could refer to their intelligence or may be in reference to their dress. Similarly, it was presumed that descriptions like ‘strong’ were in reference to physical appearance, but they could refer to emotional strength. Asking more direct questions (e.g., ‘How likely would this man be to win an arm wrestle?’) would allow for some further clarity here such that there is less ambiguity in interpretation of muscularity perceptions.

Whilst the manipulation phases used for each of the samples were very similar, there were some fundamental differences in terms of stimuli used. Sample 1 manipulation stimuli were made up of 24 CGI images and 24 naked (genitals obscured) photos of high (condition 1) or low (condition 2) muscle mass bodies as described in Study 6 methods. However due to the ethical requirements of the study, younger participants (Samples 2 and 3) were instead shown photographs of either high, or low, muscle mass males from male clothing websites (e.g., Father Sons Clothing and Fred Perry) for their manipulation stimuli. Therefore, we must consider a potential explanation for the lack of significant interaction between phase and condition amongst those in Samples 2 and 3 could be the different manipulation stimuli used with these samples. Specifically, one could argue the stimuli used for Samples 2 and 3 may not have been muscular enough to induce muscularity visual diet effects. It should be noted, however, that the same stimuli used with Samples 2 and 3 have also been used successfully as manipulation stimuli in similar previously published work (e.g., Jacques, Evans and Boothroyd, 2021) where we found no difference between the strength of musculature visual diet effects for the high status, clothed stimuli (used with Samples 2 and 3), and the ‘neutral’ naked stimuli (used with Sample 1). Furthermore, Jacques, Evans and Boothroyd (2021) had these stimuli pre-rated for muscularity and this revealed that, for the high muscle mass stimuli, the clothed images (used as manipulation imagery for Samples 2 and 3) had higher muscularity ratings (mean value= 7.337) than the high muscle mass photographs of nude men (mean value=4.840) that were used as manipulation imagery for Sample 1. With this in mind, we would expect that high muscle mass manipulation images used for Sample 2 and 3, should have a *greater* influence on increasing preferences for muscularity than the equivalent high muscle mass images used with Sample 1. The fact that we do not see this implies that the 6-11-year-olds (Sample 2) and 8-14-year-olds (Sample 3) may simply not be susceptible to muscularity visual diet effects, perhaps because they are not particularly preoccupied with muscularity at this age. Nevertheless, future work may seek to build upon the current study findings by using the same stimuli for all age groups to remove stimuli differences as a potential confound such as to gain a clearer picture here.

CGI images were used in all preference trials as well as making up some of the manipulation images for Sample 1. Whilst these CGI images were highly controlled, with only muscularity manipulated, stimuli would arguably be more ecologically valid if we were to present *only* photographs of real bodies that *naturally* vary in muscle mass. Having said this, such photographs were used for the manipulation stimuli presented to Samples 2 and 3, although not for the preference stimuli here. One could also argue that there exists plenty of media imagery targeted at children and adolescent groups that makes use of animated characters with exaggerated features and, indeed, previous work has shown that such animated characters can affect one's body image in the same way real human actors and actresses would (e.g., Anschultz et al, 2009).

4.4.5. Conclusions

In summary, findings reveal, amongst 11-18-year-olds, there is a positive relationship between age and SATAQ-4 scores (for both boys and girls) and DMS scores (for boys only), as well as baseline preferences for muscularity (in boys and girls) suggesting that as one progresses through adolescence, their preoccupation with muscle mass in males increases and, so too does their internalisation of cultural body ideals (in girls and boys) and their drive for muscularity (in boys only). Findings also revealed that viewing images of high (low) muscle mass male bodies increased (decreased) one's later preferences for muscularity, although it was only older boys (those aged 15-18-years old) who showed this effect when data was broken down by gender and age. There were more similarities than differences in the themes 6-18-year-olds drew on to describe high (low) muscle mass images. This is particularly interesting as when viewed alongside Study 5 and 6 findings it appears that whilst one's muscular body ideals, drive for muscularity, muscularity preferences, and susceptibility to muscularity visual diet effects are higher in older age groups (as per Study 5 and 6 findings), one's conscious, self-reported muscularity perceptions do not vary across the age groups. Findings imply that boys aged 15-18-years-old (in comparison to their younger peers) are likely to experience significant increases in their preferences for the male muscular physique as a result of exposure to high muscle mass imagery, like the unrealistic male body types often depicted in Western media. Therefore, interventions aimed at reducing the negative impact of idealised Western media imagery would perhaps be best targeted at this group as a means to prevent the development, maintenance, or intensification of preferences for unrealistic, largely unattainable muscular physiques and unrealistic body standards in these young people.

Chapter 5.

Visual attention towards muscular male bodies and shifts in male musculature preferences in men and women

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This chapter describes Studies 8 and 9 which sought to build upon the current limited work examining attentional bias towards male muscularity. Whilst the previous studies described in the empirical chapters of this thesis provide evidence that male musculature preferences can be manipulated in men, women, boys and girls, they do not tell us whether this is likely driven by an increased attentional bias towards high muscle mass male bodies. Dot probe (Study 8) and eye tracking (Study 9) paradigms were used to explore whether such a bias exists, whether internalisation of cultural body ideals, pressure to achieve such ideals and/or one's levels of pre-existing body concerns could predict this attentional bias, and whether this bias could increase preferences for muscularity. In Study 8, 56 men and 129 women viewed 48 paired images of high and low muscle mass males and subsequently responded to a red dot that appeared in place of either image type. In Study 9, eye tracking equipment measured bias in visual attention (% first fixations, % dwell time, and % total number of fixations) when 42 men and 55 women viewed 20 slides that each displayed an array of 6 male bodies (3 high and 3 low muscle mass). Preferences for muscularity were measured at the start and end of each study, and participants also completed SATAQ-4 and DMS measures. In both studies, men and women showed an attentional bias towards high muscle mass male bodies. Internalisation of cultural body ideals (Study 8 and 9) and pre-existing muscularity concerns (Study 9) positively predicted measures of muscularity bias. In Study 8, but not Study 9, men who strongly internalised muscular body ideals were more likely to experience shifts in their preferences for muscularity following image viewing.

5.1. Introduction

5.1.1. Background

As noted in previous chapters, excessive visual exposure, via media, to a distorted range of body types has been suggested as one possible cause of high rates of body dissatisfaction in industrialised countries amongst both men (e.g., Blond, 2000; Arbour & Ginis, 2006; Hargreaves & Tiggemann, 2009; Galioto & Crowther, 2013), and women (e.g., Groesz, Levine & Murnen, 2002; Hargreaves & Tiggemann, 2003; Brown & Tiggemann, 2016; Kleemans et al, 2018). It is hypothesised that visual exposure to certain body types leads to changes in how subsequently viewed bodies are perceived (e.g., Winkler & Rhodes, 2005; Joseph et al., 2016; Challinor et al., 2017; Stephen et al., 2018; Jacques, Evans & Boothroyd, 2021). Importantly, however, it is not just passive exposure which may produce this effect. Observers may also have stronger visual preference to attend to idealised bodies, and this may exacerbate any subsequent visual diet effects as a result of this visual experience.

The literature exploring biased visual attention towards certain body types has predominantly focused on women's bias towards low BMI/thin female bodies (e.g., Cho and Lee, 2013; Glauert et al., 2010). This bias may be stronger in those women who are dissatisfied with their own bodies (e.g., Cho and Lee, 2013; Joseph et al., 2016; Mousally et al., 2016; Donzilo et al, 2017; Stephen et al., 2018; Berrisord-Thompson, 2021). Indeed, a recent systematic review and meta-analysis by House et al. (2023) revealed some evidence from eye tracking studies for a positive association between body dissatisfaction and attentional bias towards low weight female bodies amongst women. Further, Stephen et al. (2018) found that visual attention towards thin bodies mediated the relationship between body satisfaction and susceptibility to the body size adaptation effect, such that those women (and men) who were most dissatisfied with their bodies, were more likely to preferentially attend to thin bodies and then subsequently show shifts in their perception of a normal body towards thinness as a result. Across the body perception manipulation literature, with the exception of Boothroyd, Tovée and Pollet (2012), it seems that both men and women who are dissatisfied with their bodies are more susceptible to visual diet effects in the body *fat* dimension (e.g., Joseph et al., 2016; Stephen et al., 2018).

The literature exploring biased *visual attention* towards *muscular* male body types has been a neglected area of study in comparison to such work on female body types (Kirby et al., 2023). Whilst some research shows males have a biased visual attention towards thin (over larger, higher adiposity) male bodies (e.g., Joseph et al., 2016 and Stephen et al., 2018), few studies have explored biased visual attention towards high muscle mass male bodies (over low muscle mass male bodies), despite this being a key aspect of male body image. From the literature that does exist, evidence from eye tracking (Cho & Lee, 2013), compound visual search tasks (Talbot et al., 2019) and dot probe paradigm studies (Jin et al., 2018) have all shown that men have an attentional bias towards muscularity and that this bias is stronger in those who are dissatisfied with their bodies. However, these studies investigated visual attention towards male muscularity in Chinese (Cho and Lee, 2013; Jin et al., 2018) or Australian (Talbot et al., 2019) men only and, as such, the studies presented in this chapter sought to explore whether such results can be replicated with a UK mixed gender sample. Indeed, cross-cultural work has shown that East Asian men, in comparison to Western men from the US, may be *less* concerned with male muscularity scoring lower on the drive for muscularity and selecting less muscular figures to represent their ideal body than those men from the Western group (Jung, Forbes & Chan, 2010).

In terms of attentional bias trial design, previous muscularity attentional bias work has explored whether attentional bias exists when participants are presented with (i) one thin, one 'normal', one muscular and one fat body at the same time (Cho & Lee, 2013); (ii) an array of 8 bodies that are either average, obese or muscular (Talbot et al., 2019); or (iii) a neutral stimulus (car exterior) paired with either a high or low muscle mass male body (Jin et al., 2019). Such stimuli presentation designs have thus never sought to explore attentional bias in stimuli that varies *only* in muscularity. The studies that have been carried out and are presented in this chapter are therefore the first of their kind to explore whether attentional bias towards muscularity exists when participants are presented with just two stimuli types together on screen at the same time; a high and a low muscle mass male body (Study 8), and when participants are asked to freely view an array of male bodies; 3 high and 3 low muscle mass male bodies (Study 9). Presenting just two stimuli for each of the Study 8 trials was intended to simplify stimulus presentation design. Specifically, because previous musculature attentional bias work has involved more complex visual scenes e.g., has presented not just muscular stimuli but those of differing adiposity too (e.g., Cho & Lee, 2013; Talbot et al., 2019), or used muscular images alongside neutral, non-body stimuli (e.g., Jin et al., 2019), any attentional bias effects may have been somewhat masked. As such, it was felt that presenting just one high and one low muscle mass male for each trial was a necessary, and novel stimulus presentation design. Indeed, this stimulus presentation design is similar to that of an equivalent body attentional bias study (Stephen et al., 2018) that showed an attentional bias in men and women towards thin bodies when presented with paired images of high and low body fat bodies. Study 8 seeks to explore whether Stephen et al.'s stimulus presentation design will still reveal men and women to have an attentional bias towards the more idealised body type (i.e., the high muscle mass male) when using stimuli that vary only in muscularity. For Study 9's stimulus presentation design, using eye tracking, we sought to explore whether such attentional bias would still exist when there were additional bodies presented as part of an array of six bodies on screen, with three from one stimulus category (high muscle mass males) presented alongside three from another (low muscle mass males). Again, like the stimuli of Study 8, Study 9 stimuli *only* varied in muscularity, and, as such, any bias in visual attention towards a body is likely due to the perceived muscularity of that body. To our knowledge, there are no other eye tracking studies that have sought to explore attentional bias in this way and thus this is a novel design worthy of exploration.

In terms of manipulation of musculature preferences, research supports the idea that one's perception of 'normal' levels of male muscularity can change following exposure to high or low muscle mass manipulation images (e.g., Brooks et al., 2020; Sturman et al., 2017; Jacques, Evans & Boothroyd, 2021). However, the exploration of whether internalisation of cultural body ideals, pressure to achieve such ideals or any other pre-existing body concerns can predict the strength of such shifts in preferences has been neglected (Jacques, Evans and Boothroyd, 2021). Furthermore, no previous work has explored whether attentional bias towards muscularity when presented with mixed stimuli can potentially lead to changes in one's musculature preferences. Consequently, the current study explored the relationship between visual bias towards high (over low) muscle mass images and subsequent changes in musculature preferences, while also considering the influence of pre-existing body cognitions related to one's internalisation of cultural body ideals, perceived pressures to achieve such ideals and one's drive for muscularity in men and women.

5.1.2. Measuring bias in visual attention

Dot probe (Study 8) and eye tracking (Study 9) paradigms were used to explore the research questions described above. The dot-probe test measures attentional bias without eye-tracking, by measuring reactions times to stimuli cued by one stimulus versus another. Typically, two images are displayed simultaneously for a brief duration of around 100-1000 milliseconds and then disappear; in place of one of the images, a single target probe (usually a dot or letter) will appear. Participants are asked to respond to the probe, typically by button-press to indicate the side or type of probe, and their reaction time (RT) is measured. Any attentional bias towards either image is then determined by assessing whether one is quicker to respond to a target probe that replaces one image versus the other. Early dot probe paradigm research has traditionally explored emotional attention, specifically attentional bias to threat (e.g., Eysenck et al., 1987). However, more recently, work has started to explore bias in visual attention towards specific body types (e.g., Glauert et al., 2010; Jin et al., 2018), with those dissatisfied with their own bodies showing faster responses to idealised bodies.

Eye tracking studies have sought to measure attentional bias towards idealised body types more directly, recording how many fixations are directed towards the idealised body, which body type receives the first fixation, and how long one looks at each body type for (i.e., total dwell time) (e.g., Cho & Lee, 2013; Stephen et al., 2018; House et al., 2023). Such work, much like the aforementioned evidence from dot-probe studies, suggests those who are dissatisfied with their own bodies may show more attentional bias towards idealised bodies.

Participants

Most of the previous work exploring biased visual attention towards muscularity in male bodies has explored it in men only (e.g., Cho and Lee, 2013; Jin et al., 2018 and Talbot et al., 2019). This means we do not know whether women, too, experience a bias in visual attention towards high (over low) muscle mass male bodies and whether this bias in attention subsequently leads to changes in musculature preferences in the direction of the body type preferentially attended to. Both men *and* women were therefore recruited as an exploratory part of this research, given that women's attentional bias towards muscularity in male bodies has been a neglected area.

5.1.3. Measuring internalisation of cultural body ideals and body concerns

Participants' internalisation of cultural body ideals was measured using the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4; Schaefer et al., 2015) and further muscularity-oriented body concerns via the Drive for Muscularity Scale (DMS; McCreary, 2007). Studies 8 and 9 assessed whether scores on the SATAQ-4 and DMS predicted (1) whether participants showed visual attentional bias towards idealised high muscle mass images of men and (2) whether scores predicted an increase in one's preferences for muscularity over the study due to attentional bias. Both the SATAQ-4 and DMS measures show good reliability and validity (McCreary et al., 2004; McPherson, 2010; Barra et al., 2019; Shaefer et al., 2015).

5.1.4. Hypotheses

Based on the literature described above, the current paper sought to explore the following hypotheses:

H1*: There will be a bias in visual attention towards muscularity in male body stimuli.*

H2: *Any bias in visual attention towards muscularity will be stronger in those men who internalise cultural body ideals, feel pressure to achieve such ideals and/or have a high drive for muscularity as measured by the SATAQ-4 and DMS.*

H3: *Any bias in visual attention will subsequently lead to changes in musculature preferences in the direction of the body type one preferentially attends to.*

5.2. Study 8: Examining bias in visual attention towards muscularity using the dot probe paradigm.

5.2.1. Method

5.2.1.1. Participants

The study was conducted remotely online, programmed in PsychoPy Version 3 (Peirce, 2017), and hosted on Pavlovia. Participants were recruited from Durham University's departmental participant pool, word of mouth and snowball sampling. One hundred and eighty-six (56 male, 129 female and 1 non-binary) participants aged between 18 and 23 were recruited, with an average age of 19 for both male and female groups. Most participants (84% of men and 71% of women) described their sexual orientation as 'exclusively heterosexual'. This sample size exceeds that of Joseph et al.'s (2016) study exploring attentional bias in men and women to own gender bodies and Cho and Lee's (2013) eye tracking work into a bias towards muscularity in male bodies. Further, the current paper's sample size closely matches that of other studies exploring body dissatisfaction and its links to attentional bias towards specific body types (e.g., Jin et al., 2018 and Talbot et al., 2019). All participants provided informed consent before taking part and were shown a debrief statement once they had completed all trials which provided the research team's contact details, gave background information about the study and provided a web link to a body image support website. Ethical approval was gained from Durham University's Psychology Department Ethics Committee.

5.2.1.2. Internalisation of cultural body ideals and body concerns

After providing their age, gender and sexual orientation, participants completed the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4; Schaefer et al., 2015) and the Drive for Muscularity Scale (DMS; McCreary, 2007) which are both described in the previous chapters of this thesis.

5.2.1.3. Stimuli

The stimuli for this study were those 6 high and 6 low muscle mass CGI stimuli that were used and described in the previous empirical work of this thesis (e.g., in Chapter 2; Jacques, Evans, Boothroyd et al., 2021) The 6 muscular male images had the built in 'Bodybuilder', 'Bodybuilder Details' and

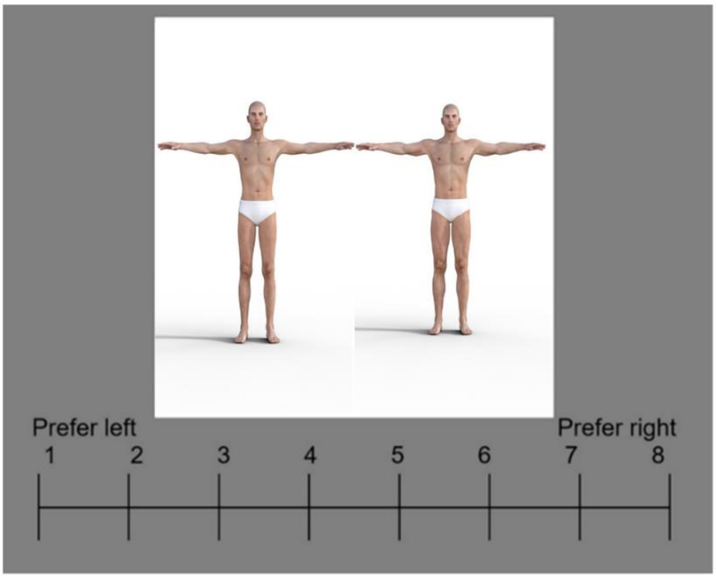
'Bodybuilder size' slider settings randomly set to either medium or high (50-100 slider value) and the 6 non-muscular male images had these set to low (0-25 slider value) as well as the 'Emaciated' slider setting set to either medium or high (50-100 slider value).

5.2.1.4. Preference for muscularity

After completing the SATAQ-4 and DMS questionnaires, participants then completed the first preference for muscularity task. Participants were presented with 6 pairs of the CGI stimuli (presented one pair at a time) and were asked to indicate which image from each pair they preferred and the extent to which they preferred it using an 8 point slider scale from '1 strongly prefer left body' (low muscle mass body) to '8 strongly prefer right body' (high muscle mass body), with the muscular body presented to the right hand side for half of all trials and the left hand side for the remaining trials, presented in a randomised order. An example preference task trial is shown in Figure 5.1.

Figure 5. 1

Example trial from the pre- and post- manipulation preference task.



Overall muscularity preference scores for the pre-manipulation preference task were generated by averaging the preference scores for each of the 6 trials. A high average score indicated a preference for high muscle mass male bodies whilst a low score indicated a preference for low muscle mass male bodies. Participants were asked to complete this preference task again following the dot probe phase to assess whether their preference for muscularity had changed.

5.2.1.5. Dot probe phase

During the dot probe phase part of the study, participants were shown further random pairings of a high muscle mass male together with a low muscle mass male body. For the dot probe trials, each of the two images on screen had their faces removed and appeared in their own box (8cm x10cm) to ensure they were perceived as separate images. An example is presented within Figure 5.2. Forty-eight paired images were created for the dot probe trials. The side on which images (high muscle mass on left versus right) and dots appeared was fully counter-balanced across trials. The paired images were presented in a randomised order.

Figure 5. 2

An example high muscle mass congruent dot probe trial (left) and a high muscle mass incongruent dot probe trial (right).

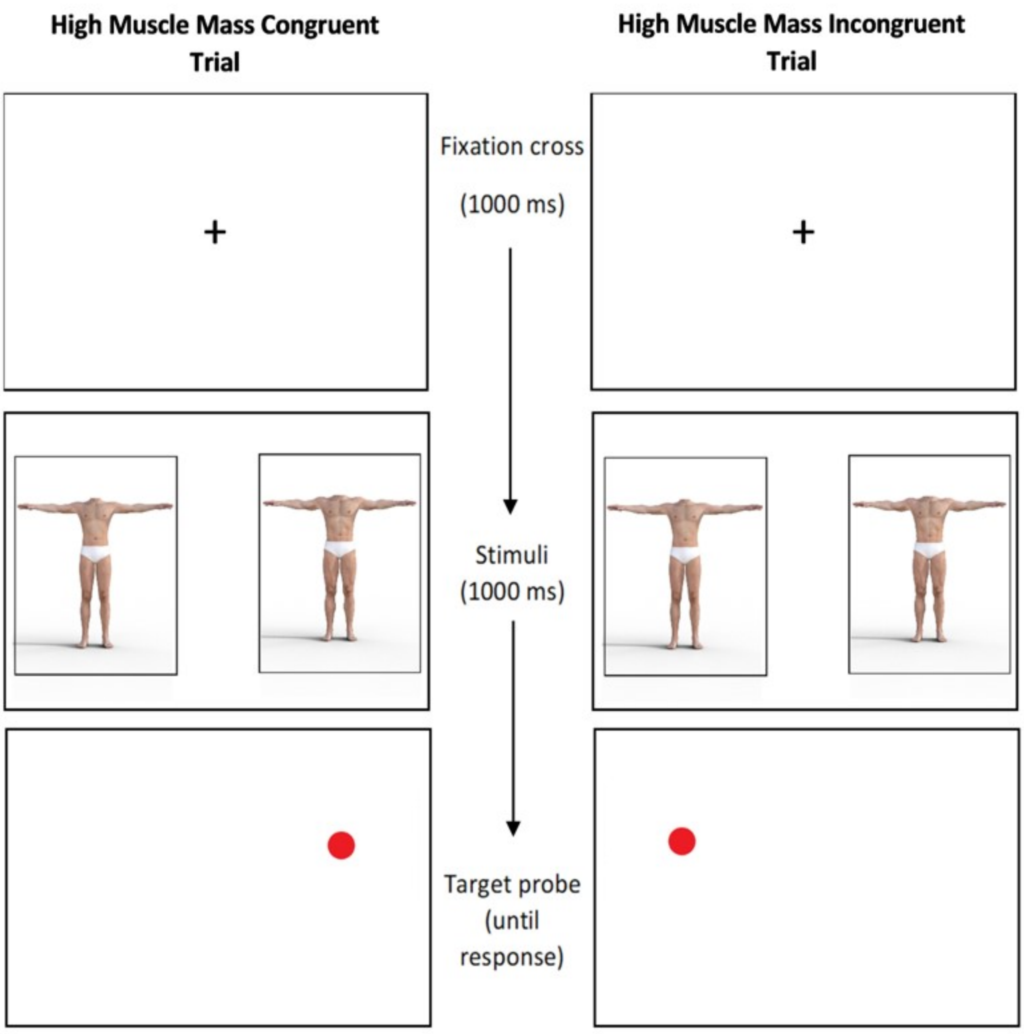


Figure 5.2 shows an example high muscle mass congruent trial (left) and a high muscle mass incongruent trial (right). Participants would first view a fixation cross which appeared in the centre of the screen for a duration of 1000ms. This was then followed by presentation of one of the paired images (a high muscle mass body together with a low muscle mass body) for a further 1000ms. Then, in place of these images, on either the left or the right hand-side, a red dot would appear in place of the upper chest area of one of the two images. Participants had been instructed to respond to this dot as soon as they saw it by clicking the 'Q' key on their keyboard if it appeared to the left and the 'P' key if it appeared to the right. Reaction times to the red dot were measured in milliseconds.

Following the 48 trials of paired dot probe images, participants were told that they needed to complete the second half of the preference task. This involved completing the same preference task as was required before the dot probe task (rating their preference for the same 6 pairs of images). Finally, participants were thanked for their participation and shown the debrief statement.

5.2.1.6. Data processing

Mean reaction times for high muscle mass congruent and high muscle mass incongruent trials were calculated for each participant. Any incorrect responses and responses that were >=2 seconds were removed from the data set, resulting in 1.2% of trials being removed. In line with similar dot probe research using bodies as stimuli (e.g., Glauert et al., 2010 and Joseph et al., 2016), attentional bias scores were calculated for each participant by subtracting the mean reaction times for target probes that replaced the high muscle mass bodies from the mean reaction times from target probes that replaced the low muscle mass bodies, then this difference was divided by the average of the two means. Positive attentional bias scores therefore indicated a bias towards high muscle mass bodies and negative scores indicated a bias towards low muscle mass male bodies.

5.2.2. Results

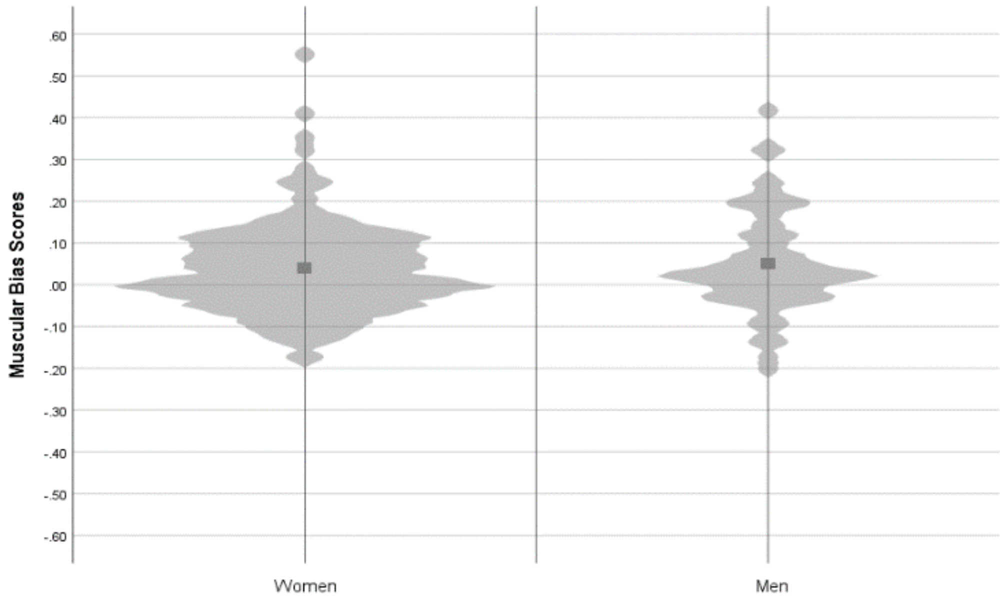
5.2.2.1. Is there a bias in visual attention towards high muscle mass male bodies?

A one-tailed, one-sample t test comparing participants' attentional bias scores (M=.04, SD=.11) to zero (which would indicate no clear bias in visual attention) revealed participants had a significant bias towards higher levels of muscularity that was greater than zero, ($t(185) = 5.137$, $p<.001$) (Cohen's d=.38) .This significant result held for both men (M=0.051, SD=.124),

($t(55)=3.095$, $p=.003$) (Cohen's $d=.41$) and women (M=.040, SD=.112), ($t(128) = 4.056$, $p<.001$) (Cohen's $d=.36$) as illustrated in Figure 5.3. An independent samples t test revealed no significant differences between men and women in their attentional bias scores ($t(183)=.595$, $p=.552$).

Figure 5. 3

Muscularity bias scores for women and men where a positive bias score is indicative of a bias in attention towards high muscle mass male bodies and a negative bias score indicates a bias towards low muscle mass male bodies. Dark grey squares represent the mean muscular bias score for each group.



5.2.2.2. Does internalisation of cultural body ideals and/or pre-existing body image concerns (as measured by the SATAQ-4 and DMS) predict muscularity bias scores?

For men, there was a positive correlation between SATAQ-4 scores and muscularity bias scores ($r=.498$, $p<.001$) as presented in Table 5.1. Given that the SATAQ-4 measures two distinct constructs (internalisation of cultural body ideals and sociocultural pressures), and the DMS measures both attitudinal and behavioural drives for muscularity, correlations were calculated for each of the SATAQ-4 and DMS subscales. This revealed that the Pressures-Peers ($r=.521$, $p<.001$) and Pressures-Media ($r=.358$, $p=.007$) SATAQ-4 subscale scores correlated positively with muscularity bias scores. However, no other SATAQ-4 subscale scores, nor DMS scores, including the individual attitudinal or behavioural DMS components, were correlated with muscularity bias scores in men (see Table 5.1).

Table 5. 1

Means (M), standard deviations (SD) and correlations summary for men and women where 'Bias Score' describes attentional bias to male muscularity scores, 'SATAQ' represents total SATAQ score, 2-7 represent scores for the 5 individual subscales making up the SATAQ-4, 'DMS' represents total DMS score and 9-10 represent scores for the attitudinal and behavioural subcomponents of the DMS.

Male Data	M	SD	2	3	4	5	6	7	8	9	10
1.BiasScore	.051	.124	.498**	.201	.260	.107	.521**	.358**	.082	.125	-.023
2. Total SATAQ	58.589	12.425		.590**	.437**	.562**	.732**	.680**	-0.79	-.021	-.114
3. Internalisation-Thin	14.036	3.899			.192	.261	.174	.209	-.181	.047	-.277*
4. Internalisation-Muscular	17.714	4.111				-.088	.222	-.023	.072	-.082	.138
5. Pressures-Family	7.589	3.405					.313*	.330*	-.174	-.048	-.190
6. Pressures-Peers	8.304	4.406						.435**	-.002	-.124	.051
7. Pressures-Media	10.946	4.688							.005	.129	-.105
8. Total DMS	48.929	14.818								.623**	.823**
9. Attitudinal	25.125	8.147									.072
10. Behavioural	23.393	11.417									
Female Data	M	SD	2	3	4	5	6	7	8	9	10
1.BiasScore	.040	.113	-.013	.058	.202*	-.183*	-.177*	.038	.170	.166	.128
2. Total SATAQ	67.853	14.413		.730**	.533**	.617**	.638**	.675**	.372**	.360**	.286**
3. Internalisation-Thin	17.791	4.781			.410**	.156	.237**	.526**	.180*	.171	.143*
4. Internalisation-Muscular	13.884	5.146				.020	.033	.179*	.583**	.517**	.503**
5. Pressures-Family	10.481	4.757					.520**	.294**	.062	.090	.013
6. Pressures-Peers	8.915	4.310						.311**	.154	.180*	.083
7. Pressures-Media	16.783	3.549							.153*	.144	.123
8. Total DMS	29.264	12.042								.892**	.855**
9. Attitudinal	16.349	7.351									.529**
10. Behavioural	12.915	6.413									

**p<.05, **p<.01.*

For women, there were significant correlations between the Internalisation-Muscular (r=.202, p=.022), Pressures-Family (r=-.183, p=.038) and Pressures-Peers (r=-.177, p=.045) SATAQ-4 subscale scores and muscularity bias scores. These are presented in Table 5.1.

5.2.2.3. Do those who show a visual attention bias towards high muscle mass (low muscle mass) males show an increase (decrease) in their preferences for muscularity following the dot probe task?

A mixed ANOVA with test phase (pre versus post- dot probe preference for muscularity) as a repeated measures variable and attentional bias score as covariate, revealed no significant interaction between phase and attentional bias score ($F_{1,184}$=3.586, p=.060, partial eta^2=.019), with full model results for data from men and women (analysed together) shown under Model 1 in Table 5.2. Mean preference for muscularity thus did not increase more in those who had biased visual attention towards the high muscle mass (over low muscle mass) male body stimuli. In fact, as shown in Figure 5.4, those with positive bias towards muscularity scores (quicker RT to muscular bodies) showed a *smaller* increase (non-significantly) in their post-dot probe preference for muscularity scores than those with negative muscularity bias scores (quicker RT to non-muscular bodies).

Table 5. 2

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and attentional bias towards muscularity score as the covariate for all participants (Model 1), just men (Model 2), just women (Model 3), and with Internalisation-Muscular SATAQ-4 subscale scores added to the model for men (Model 4). Critical tests of our hypotheses are shown in bold.

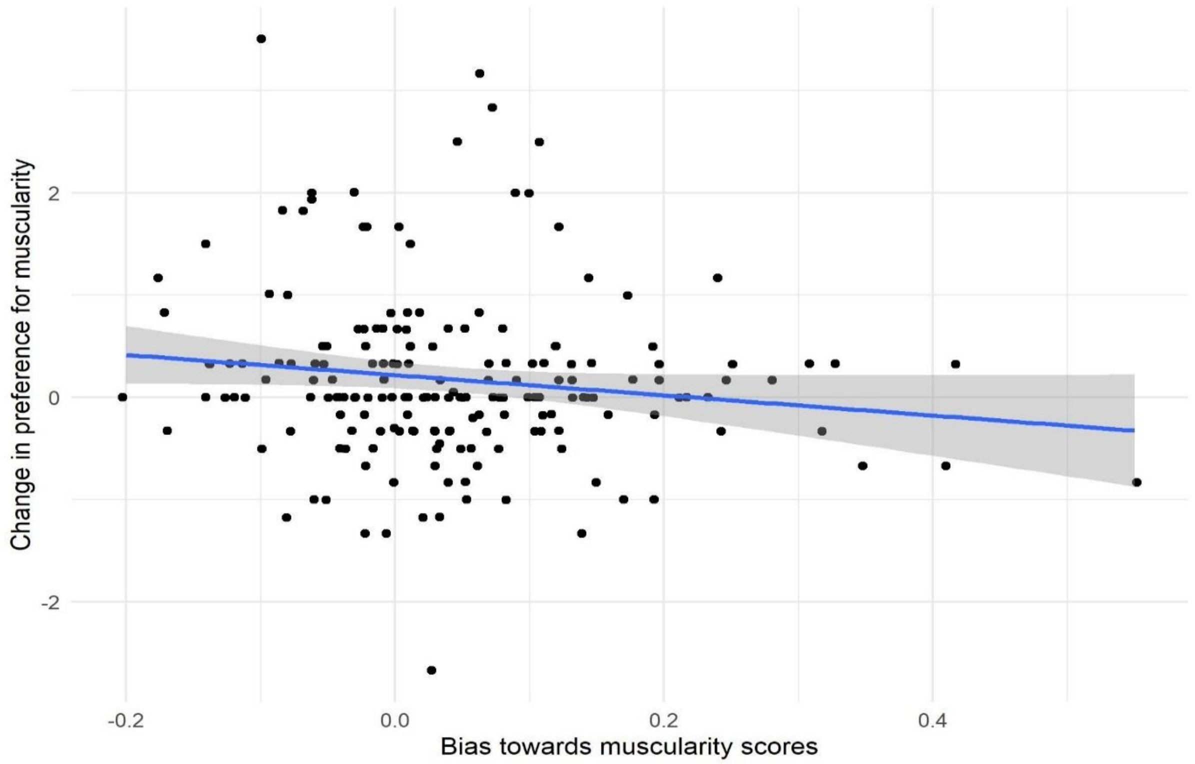
Model 1 (Men and Women)	*df*	*F*	*p*	ηp^2
Phase	1,184	11.281	.001**	.058
Attentional Bias Score	1,184	.100	.752	.001
Phase*Attentional Bias Score	**1,184**	**3.586**	**.060**	**.019**
Model 2 (Men)	*df*	*F*	*p*	ηp2
Phase	1,54	.875	.354	.016
Attentional Bias Score	1,54	.014	.905	.000
Phase*Attentional Bias Score	**1,54**	**.436**	**.512**	**.008**
Model 3 (Women)	*df*	*F*	*p*	ηp2
Phase	1,127	10.670	.001**	.078
Attentional Bias Score	1,127	.100	.869	.000
Phase*Attentional Bias Score	**1,127**	**4.644**	**.033***	**.035**
Model 4 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	2.517	.119	.046
Attentional Bias Score	1,52	.198	.658	.004
Internalisation-Muscular SATAQ-4	1,52	6.652	.013	.113
Phase*Attentional Bias Score	**1,52**	**6.104**	**.017**	**.105**
Phase*Internalisation-Muscular SATAQ-4	1,52	2.394	.128	.044
Attentional Bias Score*Internalisation-Muscularity SATAQ-4	1,52	.316	.577	.006
Phase* Attentional Bias Score*Internalisation-Muscular SATAQ-4	**1,52**	**7.398**	**.009****	**.125**

**p<.05, **p<.01*

When data for men and women was split and analysed separately, data from male participants did not reveal a significant interaction between phase and muscularity bias score ($F_{1,54}$=.436, *p*=.512, partial eta^2=.008) (see Model 2 in Table 5.2), but the female data showed a significant interaction ($F_{1,127}$=4.644, p<.04, partial eta^2=.035) (see Model 3 in Table 5.2), though not in the expected direction: women who had biased visual attention towards high muscle mass males showed a smaller increase in their preference for muscularity score post-dot probe task than those who showed a bias in attention towards low muscle mass males.

Figure 5. 4

Scatterplot of the non-significant correlation between attentional bias towards muscularity scores against changes in preferences for muscularity scores post-dot probe task where 0 on the Y axis represents no preference to either image presented and 0 on the X axis represents no difference in reaction times to the high muscle mass versus low muscle mass images. Grey areas represent 95% confidence intervals.



5.2.2.4. Does internalisation of cultural body ideals and/or body image concerns predict the strength of any changes in musculature preferences following image viewing ?

Whilst there was no two-way interaction between phase and muscularity bias scores, analyses did reveal a significant interaction between phase, muscularity bias score and SATAQ-4 Internalisation-Muscular subscale scores for men ($F_{1,52}$=7.398, p=.009, partial eta^2=.125) as presented in Table 5.2 (Model 4). When Internalisation-Muscular SATAQ-4 subscale scores were mean-split (M=17.7143, SD= 4.1108), for those men scoring more than the mean, analyses revealed a significant interaction between phase and muscularity bias scores ($F_{1,31}$=6.167, p<.020, partial eta^2=.166), whilst for those men who scored less than or the same as the mean, there was no such significant interaction ($F_{1,21}$=2.521, p=.127, partial eta^2=.107), such that men who strongly internalise muscular body ideals are more likely to experience shifts in preferences for muscularity in the direction of the body type they preferentially attend to compared to those men who internalise less. Internalisation-Muscular SATAQ-4 subscale score was the only internalisation of cultural body ideals/ body image concern measure that produced a significant three-way interaction for men. There were no such significant interactions with the data from women. All other non-significant models are presented in Appendix E.

5.2.3. Interim Discussion

The purpose of Study 8 was to explore whether a bias in visual attention towards muscular male bodies in men and women in the UK exists, whether this bias is stronger in those who internalise cultural body ideals and/or those with pre-existing body concerns and whether any bias in visual attention can affect later preferences for muscularity.

5.2.3.1. H1: There will be a bias in visual attention towards muscularity in male body stimuli

In line with previous research (e.g., Cho & Lee, 2013; Jin et al., 2018 and Talbot et al., 2019), the first hypothesis was supported as findings show that men (and women) showed a bias in visual attention towards high muscle mass (over low muscle mass) male bodies. Not only does this confirm the findings of previous muscularity attentional bias work, but it also goes beyond the current literature by showing attentional bias towards muscularity when participants are shown just two stimuli categories together on screen (high versus low muscle mass males) as opposed to viewing 4 to 8 images of different body types at a time (e.g. Cho & Lee, 2013 and Talbot et al., 2019), or a body alongside a neutral stimulus (Jin et al., 2018). Further, Study 8 extends the current literature by showing that women, too, experience a bias in visual attention towards high (over low) muscle mass males. As such, this work is the first dot probe experiment, using paired high and low muscle mass males, to show such a bias in women.

5.2.3.2. H2: Any bias in visual attention towards muscularity will be stronger in those men who internalise cultural body ideals, feel pressure to achieve such ideals and/or have high a high drive for muscularity as measured by the SATAQ-4 and DMS.

Study 8 findings also provide evidence for hypothesis 2 as the bias in visual attention towards muscular male bodies was stronger in those men who had internalised cultural body ideals and/or felt pressure to achieve such ideals. Specifically, there was a positive correlation between SATAQ-4 scores (total SATAQ-4 scores, as well as the Pressures-Peers and Pressures-Media subscale scores) and muscularity bias scores in men. This finding is, again, consistent with previous muscularity bias research (Cho & Lee, 2013; Jin et al., 2018; Talbot et al., 2019) which has found that men with pre-existing body concerns have an attentional bias towards high muscle mass male bodies.

The lack of positive relationship between either the DMS measures or the Internalisation-Muscular SATAQ-4 subscale with muscularity attentional bias scores in men is somewhat unexpected. However, the relationship between Internalisation-Muscular SATAQ-4 subscale scores and muscularity bias scores was approaching significance (p=.053). Thus, highlighting the need for replications such as to further ascertain whether such measures can indeed predict muscularity bias.

Indeed, for women, Internalisation-Muscular SATAQ-4 subscale scores *was* positively related to muscularity bias scores, suggesting that those women who value muscularity/athleticism in terms of their own body, may have an attentional bias towards muscular characteristics in the opposite sex too. Notably, recent research by Talbot and Mahlberg (2022) revealed that women who rated their own body muscularity as high also rated highly muscular male bodies as more attractive than did those women who had lower levels of muscularity themselves.

Interestingly, for women, the ‘Pressures-Family’ and ‘Pressures-Peers’ SATAQ-4 subscale scores were both negatively correlated with women’s muscularity bias scores such that those women who scored high on such measures looked at high muscle mass male bodies less (see Table 5.1). These subscale scores are based on perceived pressures to be ‘thinner’ and to decrease levels of ‘body fat' as a means to make one feel more 'attractive'. Legenbauer et al. (2009) found similar findings to those reported in Study 8 in that high levels of weight/shape dissatisfaction in women was a negative predictor of preferences for attractive partners. Authors here argue that this may be because those dissatisfied women who feel the pressure to be thin and reduce body fat may believe they cannot compete with other women for attractive opposite sex partners. Furthermore, discomfort with one's own body may mean one reduces emphasis on attractiveness of their own partners in the hope that a less attractive partner will be more accepting and less critical of their own looks. In the context of Study 8, these explanations may also apply. Specifically, women who feel pressure from their peers and family to improve their appearance divert their attention away from the more muscular male bodies as a means to avoid rejection and avoid someone who may be less accepting of their own body. However, it should be noted that other SATAQ-4 subscale scores did not negatively predict attentional bias towards muscular males in women. Though, this may simply be because it is only perceived pressures from *other people* that affects visual attention in the context of male muscularity.

5.2.3.3. H3: Any bias in visual attention will subsequently lead to changes in body type preferences in the direction of the image type one preferentially attends to

In terms of hypothesis 3, there was no significant two-way interaction between phase and attentional bias score for men. Those men who showed a bias in visual attention towards high muscle mass (low muscle mass) male bodies did not show an increase (decrease) in their preferences for muscularity post-dot probe task. Interestingly, there was such a significant two-way interaction for women, though this was not in the predicted direction. Specifically, those women with an attentional bias towards high muscle mass males showed a smaller increase in their preference for muscularity scores post-dot probe task than those women who showed a bias in visual attention towards low muscle mass male bodies. So, whilst previous work suggests viewing images of high (low) muscle mass males should increase (decrease) one's preference for muscularity (Jacques, Evans & Boothroyd, 2021), it seems that biased visual attention as measured by reaction times in the dot probe trials within the current study does not seem to lead to significant changes in musculature preferences in the direction of the body type one preferentially attends to. This is in line with the work of House et al. (2022) who found that women who has been trained to attend to high fat bodies using a dot probe task in laboratory settings, did not subsequently show any evidence of body size after-effects.

However, Study 8 findings did reveal a significant three-way interaction involving Internalisation-Muscular SATAQ-4 subscale scores for men. Specifically, for those men who strongly internalised muscular body ideals (i.e., for those men with the highest Internalisation-Muscularity SATAQ-4 subscale scores) there was a significant two-way interaction between phase and attentional muscularity bias score, whilst no such significant interaction existed for those men with lower Internalisation-Muscular SATAQ-4 subscale scores. Specifically, men with high Internalisation-Muscular SATAQ-4 subscale scores showed an increase (decrease) in preferences for muscularity if they showed an attentional bias towards high (low) muscle mass male bodies during the dot probe task, whilst those with lower subscale scores did not. This is in line with equivalent work on women that shows those who are most concerned with their bodies are more likely, than those less concerned with their bodies, to experience significant shifts in perceptions of body fat normality (e.g., Joseph et al., 2016 and Stephen et al., 2018, although cf. Boothroyd, Tovée & Pollet, 2012).

5.3. Study 9: Examining bias in visual attention towards muscularity using eye tracking.

Because Study 8 used the dot probe paradigm, which is limited in terms of what it can tell us about attentional bias, we do not know whether there was actually biased visual fixation towards high muscle mass images over low muscle mass images in those participants. For example, the paradigm cannot provide details as to the location of participants' first fixation, number of fixations to either image type, or the fixation duration towards each image type. These factors could all affect whether subsequent changes in one's musculature preferences could occur, but cannot be measured under the dot probe paradigm. Moreover, the dot probe paradigm has various other limitations including potentially poor internal consistency and test-retest reliability (e.g., Schmukle, 2005) and, indeed, a recent meta-analysis by House et al. (2023) revealed that for women viewing female body stimuli at least, there was no evidence for a positive association between body dissatisfaction and attentional bias towards low weight bodies in studies using the dot probe paradigm, however, there *was* some evidence for such a positive association from eye tracking studies. They conclude that total 'gaze duration' is a more reliable measure of attentional bias than bias scores generated from reaction times using the dot probe paradigm (Waechter et al., 2014), and that the dot probe task is not reliable enough to detect a positive relationship between body dissatisfaction and attentional bias towards low-weight body types. With this in mind, Study 9 used eye tracking to specifically measure the direct visual attention of participants and thus more clearly estimate any male muscularity bias that exists in men and women, and how it may lead to changes in male musculature preferences. For Study 9, the number of stimuli presented for each of the attentional bias trials was increased to six. Specifically, whilst there were still two stimuli categories (high versus low muscle mass male bodies), there were six images presented on screen for each trial; three high, and three low muscle mass male bodies. This stimulus presentation design was chosen as it allowed us to examine whether an attentional bias towards male muscularity could still be observed when the visual scene was more complex i.e., when there were six bodies of varying muscle mass as opposed to just two.

5.3.1. Method

5.3.1.1. Participants

Participants were recruited from Durham University's Psychology Department Participant Pool, word of mouth and snowball sampling. Ninety-seven (42 male, 55 female) participants aged between 18 and 26 were recruited, with an average age of 20 for both men and women. Participants could only participate if they had normal vision and were not eligible to participate if they had been previously or were currently diagnosed with an eating disorder. Most participants (81%) reported their sexual orientation as "heterosexual", 2.4% as gay or lesbian, 9.5% as bisexual, 2.4% selected 'other' and 2.4% preferred not to answer.

5.3.1.2. Apparatus

Stimulus presentation was controlled by PsychoPy on a 22-inch HP P1230 CRT Monitor with a resolution of 1024 x 768 pixels and 32-bit colour depth. Eye-position data of the right eye were recorded with a remote EyeLink 1000 system (SR Research Ltd., Mississauga, Ontario, Canada) with a sampling rate of 1000 Hz (accuracy: 0.5°; precision: 0.01° RMS). Viewing was binocular. The distance between the participant's eyes and the monitor was 60 cm and their head was stabilized with a chin rest.

5.3.1.3. Eye tracking: six image trials stimuli and procedure

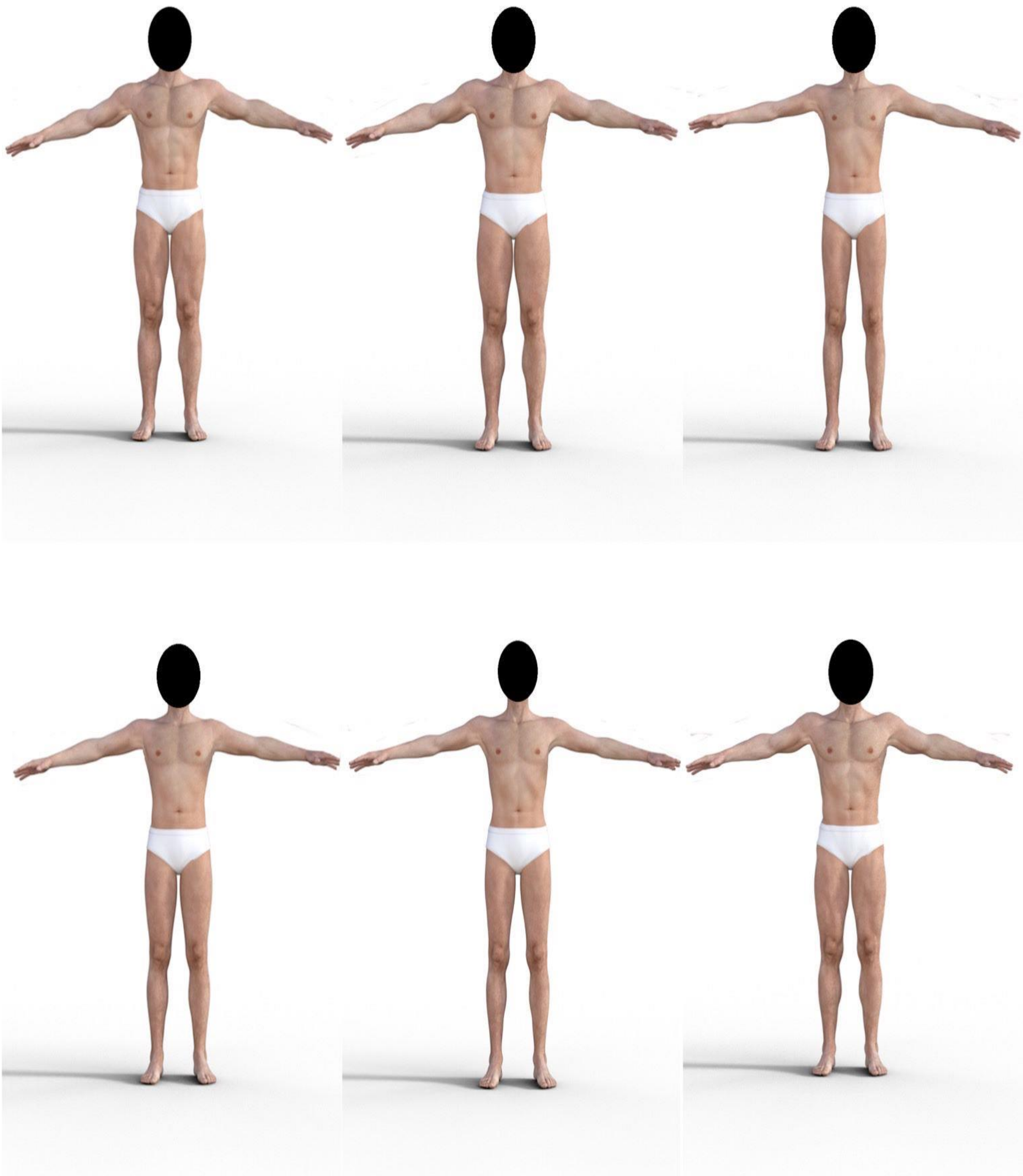
After providing their age, gender and sexual orientation, participants completed the Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4; Thompson et al, 2011), and the Drive for Muscularity Scale (DMS; McCreary, 2007), followed by the baseline preference for muscularity task as in the dot probe study.

Participants were then instructed to complete the eye tracking phase of the study whereby they were asked to freely view an array of six images of different bodies (three high muscle mass and three low muscle mass), presented together on screen at the same time. The stimuli used in this study were the same as those used in Study 8. Participants were told that each set of 6 images would be shown on screen for 4 seconds and that there would be 20 trials in total. Before the task commenced, calibration was performed by asking participants to follow calibration dots displayed at one of five positions: three on the horizontal axis and two on the vertical axis. Upon validation of calibration, the instructions for the first task were displayed and participants were prompted to click the screen when they were ready to start the experiment. Participants were asked to keep their heads as still as possible and to consistently keep their eyes on the screen during the whole experiment. The trials then began with a central fixation cross presented for 1 second, after which they could view the images freely.

To create the trials for this part of the study, three randomly selected stimuli from the six high muscle mass DAZ stimuli category were presented with three randomly selected stimuli from the six low muscle mass DAZ stimuli category. This meant that, for each trial, participants were always presented with the same three high and three low muscle mass images (see Figure 5.5 for an example trial). Twenty trials were created in total which allowed for all possible layout arrangements of the six bodies. Eye tracking equipment measured which of the six bodies on screen received the first fixation, the total number of fixations for each of the six bodies, and the duration of each fixation when participants were simply instructed to freely view the images on screen.

Figure 5. 5

Example trial from the six image trial part of the study.



5.3.1.4. Post- eye tracking preference for muscularity trials

Following the six-image trials, participants were told that they needed to complete the second half of the preference task. This involved completing the same preference task as before to give a post-eye-tracking preference for muscularity score for each participant.

3.3.1.5. Data processing

Six regions of interest (ROI) were identified and these related to the locations of each of the 6 image types: top-left, top-middle, top-right, bottom-left, bottom-middle, bottom-right. Saccades and fixations were detected using the built-in EyeLink saccade/fixation-detection algorithm with the default parameters. Only fixations that (1) followed a saccade that occurred at least 80ms after image onset, (2) were longer than 80 ms, and (3) were falling within a ROI were analysed. The first fixation was defined as the very first fixation on a ROI, this allowed us to calculate each participant's average percentage of first fixations directed towards the high muscle mass images across each of the 20 trials. Further, we measured the total time spent fixating (dwell time) and the total number of single fixations on each ROI in order to calculate the percentage of total dwell time that was directed towards the high muscle mass males, as well as the total number of fixations directed towards high muscle mass bodies as a percentage of total fixations overall across all 20 trials. Three participant responses had to be excluded from analysis due to signal loss that had affected >=10% of their trials.

5.3.2. Results

5.3.2.1. Is there a bias in visual attention towards high muscle mass male bodies?

5.3.2.1.1. Percentage of first fixations directed towards the high muscle mass males

A one-tailed, one-sample t test comparing participants' average percentage of first fixations directed towards high muscle mass male bodies (M= 50.479, SD=7.261) to 50% (which would indicate no clear bias in visual attention) revealed no significant bias in first fixations towards higher levels of muscularity, ($t(93) = .639$, p=.262) (Cohens d=.07). An independent samples t test revealed a significant difference between men and women's average percentages of first fixations directed towards high muscle mass bodies ($t(92)$=-2.798, p=.006) (Cohen's d=.59). To investigate this further, data was split by gender and a two-tailed, one-sample t test was carried out for male and female data separately, again comparing their percentage of first fixations towards high muscle mass bodies to

50%. Men did not show an attentional bias towards high muscle mass in terms of percentage of first fixations directed towards high muscle mass images (M= 48.077, SD=6.651). There, instead, was a bias in attention away from the high muscle mass male bodies for first fixations, though this was non-significant, (t (38)=-1.806, *p*=.08) (Cohen's d=-.29). Women, on the other hand, showed a significant bias in first fixations towards high muscle mass males (M=52.182, SD=7.250), (t(54) = 2.232, *p*=.030) (Cohen's d=.30).

5.3.2.1.2. Percentage dwell time towards high muscle mass males

A one-tailed, one-sample t test comparing the percentage of total dwell time participants spent looking at high muscle mass images on average across all 20 trials (M= 61.028, SD=8.131) to 50% (which would indicate no clear bias in visual attention) revealed a significant bias in dwell time directed towards high muscle mass male bodies, ($t(93) = 10.412$, $p<.001$) (Cohen's d=1.04), which held for both men (M= 63.411, SD=10.235) ($t(38) = 8.182$, $p<.001$) (Cohen's d=1.31) and women (M= 59.338, SD=10.622) ($t(54) = 6.520$, $p<.001$) (Cohen's d=.88).

5.3.2.1.3. Percentage of total fixations towards high muscle mass males.

A one-tailed, one-sample t test comparing the percentage of total number of fixations directed towards high muscle mass images on average across all 20 trials (M= 58.732, SD=8.131) to 50% (which would indicate no clear bias in visual attention) revealed a significant bias in number of fixations directed towards higher levels of muscularity, ($t(93) = 10.085$, $p<.001$) (Cohen's d=1.07), which held for both men (M= 59.538, SD=8.254) ($t(38) = 7.216$, $p<.001$) (Cohen's d=1.16) and women (M= 58.160, SD=8.069) ($t(54) = 7.500$, $p<.001$) (Cohen's d=1.01).

5.3.2.2. Does internalisation of cultural body ideals and/or pre-existing body image concerns (as measured by the SATAQ-4 and DMS) predict muscularity bias scores?

For men, there were positive correlations between percentage dwell time directed towards high muscle mass males and Internalisation-Muscular SATAQ-4 subscale scores (r=.394, p=.007), as well as with total DMS score (r=.483, p=.001), and the attitudinal (r=.398, p=.006) and behavioural (r=.409, p=.005) subcomponents of the DMS. For women, the only positive correlation was between percentage dwell time directed towards high muscle mass males and Internalisation-Muscular SATAQ-4 subscale scores (r=.314, $p<.020$).

In terms of attentional bias towards muscularity as measured by percentage of first fixations directed towards high muscle mass male bodies, this measure was positively correlated with the behavioural DMS component for men (r=.330, p=.040), whilst it was negatively with 'Pressures-Peers' (r=-.265, p=.025) and 'Pressures-Media' (r=-.237, p=.041) SATAQ-4 subscale scores for women.

Percentage of total fixations directed towards high muscle mass males was not significantly correlated with any of the SATAQ-4 or DMS measures for either men or women. A summary of all correlations involving the three measures of attentional bias towards muscularity and all SATAQ-4 and DMS measures is presented in Table 5.3.

5.3.2.3. Do those who show a visual attention bias towards high muscle mass males show an increase in their preferences for muscularity following image viewing?

A mixed ANOVA with test phase (pre versus post preference for muscularity) as a repeated measures variable and attentional bias score as covariate, revealed no significant interaction between phase and attentional bias as measured by: i) percentage of first fixations towards high muscle mass bodies ($F_{1,92}$=1.242, p=.268, partial eta^2=.013), ii) percentage of total dwell time directed towards high muscle mass bodies ($F_{1,92}$=.700, p=.405, partial eta^2=.008), and percentage of total fixations directed towards high muscle mass bodies ($F_{1,92}$=.002, p=.962, partial eta^2=.000). Full model results when data from men and women was analysed together is presented under Models 1, 2 and 3 in Table 5.4.

When data for men and women were split and analysed separately, there were still no such significant interactions (see Models 4-9 in Table 5.4). Therefore, in line with Study 8, mean preference for muscularity scores did not increase more in those who had biased visual attention towards the high muscle mass male body stimuli when looking at data from all men and all women. Though, unlike Study 8 where findings showed a significant three-way interaction between phase, attentional bias score and Internalisation-Muscular SATAQ-4 subscale scores for men, when DMS and SATAQ-4 measures were added to the model for Study 9 data there were no three-way interactions.

Table 5. 3

Means (M), standard deviations (SD) and correlations summary for men and women where '% Dwell time' describes the percentage of time participants spent looking at high muscle mass males, where '% First fixation' describes the percentage of times a high muscle mass male was the first image a participant directed their attention towards and where '% Total fixation' describes how many total fixations were directed towards the high muscle mass male bodies. 'Total SATAQ' represents total SATAQ score, and 5-9 represent scores for the 5 individual subscales making up the SATAQ-4. 'Total DMS' represents total DMS score, and 11-12 represent scores for the attitudinal and behavioural subcomponents of the DMS.

Male Data	M	SD	2	3	4	5	6	7	8	9	10	11	12
1. % Dwell time	63.411	10.235	-.049	.504**	.203	-.019	.394**	.125	.109	.008	.483**	.398**	.409**
2. % First fixation	48.077	6.651		.063	.111	.000	.167	-.037	.210	.007	.210	.006	.330*
3. % Total fixation	59.538	8.254			-.108	-.028	.079	-.207	-.157	-.055	.113	.047	.148
4. Total SATAQ	53.256	12.928				.628**	.437**	.725**	.797**	.648**	.182	.280*	.021
5. Internalisation-Thin	13.205	3.840					.243	.263	.421**	.130	-.157	.022	-.282
6.Internalisation-Muscular	15.180	4.465						-.040	.018	.081	.633**	.477**	.579**
7.Pressures-Family	7.180	3.899							.745**	.428**	-.101	.063	-.233
8.Pressures-Peers	7.462	3.858								.447**	-.001	.127	-.136
9.Pressures-Media	10.231	4.112									.218	.164	.050
10. Total DMS	2.906	.852										.834**	.842**
11. Attitudinal DMS	3.689	1.061											.405**
12. Behavioural DMS	2.377	1.092											
Female Data	M	SD	2	3	4	5	6	7	8	9	10	11	12
1. % Dwell time	59.338	10.622	.214	.535**	.047	.100	.314**	-.017	-.174	-.088	.165	.114	.199
2. % First fixation	52.182	7.250		-.023	-.197	-.220	.112	-.170	-.265*	-.237*	.043	.008	.080
3.% Total fixation	58.160	8.069			.047	.053	.106	.080	.014	-.090	.090	.008	.175
4. Total SATAQ	64.164	16.929				.749**	.623**	.821**	.762**	.759**	.557**	.561**	.454**
5. Internalisation-Thin	16.491	3.929					.355**	.545**	.408**	.540**	.220	.266*	.125
6.Internalisation-Muscular	14.382	5.130						.300*	.269*	.307**	.709**	.676**	.626**
7.Pressures-Family	10.018	5.141							.707**	.489**	.338**	.295*	.329**
8.Pressures-Peers	8.055	4.016								.493**	.397**	.383**	.339**
9.Pressures-Media	15.218	4.710									.348**	.416**	.204
10. Total DMS	2.033	.830										.937**	.902**
11. Attitudinal DMS	2.460	1.064											.693**
12. Behavioural DMS	1.751	.860											

* $p<.05$, ** $p<.01$.

Table 5. 4

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and % of first fixations towards high muscularity, % dwell time towards high muscularity, and % total fixations directed towards high muscularity as covariates for all participants (Models 1-3), just men (Models 4-6) and just women (Models 7-9).

Model 1 (Men and Women)	*df*	*F*	*p*	ηp^2
Phase	1,92	.680	.412	.007
% First Fixation to High Musc	1,92	.000	.996	.000
Phase*% First Fixation to High Musc	1,92	1.242	.268	.013
Model 2 (Men and Women)	*df*	*F*	*p*	ηp2
Phase	1,92	1.341	.250	.014
% Dwell Time to High Musc	1,92	47.304	.000	.340
Phase*% Dwell Time to High Musc	1,92	.700	.405	.008
Model 3 (Men and Women)	*df*	*F*	*p*	ηp2
Phase	1,92	.098	.755	.001
% Total Fixation no to High Musc	1,92	13.428	.000	.127
Phase*% Total Fixation no to High Musc	1,92	.002	.962	.000
Model 4 (Men)	*df*	*F*	*p*	ηp2
Phase	1,37	.280	.600	.008
% First Fixation to High Musc	1,37	.101	.753	.003
Phase*% First Fixation to High Musc	1,37	.219	.643	.006
Model 5 (Men)	*df*	*F*	*p*	ηp2
Phase	1,37	.959	.334	.025
% Dwell Time to High Musc	1,37	12.098	.001	.246
Phase*% Dwell Time to High Musc	1,37	.833	.367	.022
Model 6 (Men)	*df*	*F*	*p*	ηp2
Phase	1,37	.476	.495	.013
% Total Fixation no to High Musc	1,37	7.298	.010	.165
Phase*% Total Fixation no to High Musc	1,37	.395	.533	.011
Model 7 (Women)	*df*	*F*	*p*	ηp2
Phase	1,53	.010	.921	.000
% First Fixation to High Musc	1,53	.111	.740	.002
Phase*% First Fixation to High Musc	1,53	.087	.769	.002
Model 8 (Women)	*df*	*F*	*p*	ηp2
Phase	1,53	2.846	.097	.051
% Dwell Time to High Musc	1,53	36.901	.000	.410
Phase*% Dwell Time to High Musc	1,53	1.435	.236	.026
Model 9 (Women)	*df*	*F*	*p*	ηp2
Phase	1,53	.479	.492	.009
Total Fixation no to High Musc	1,53	6.279	.015	.106
Phase* Total Fixation no to High Musc	1,53	.093	.792	.002

$*p<.05$, $**p<.01$

5.3.3. Interim discussion

Overall, Study 9 aimed to replicate the attentional bias findings of Study 8 using eye tracking. Specifically, it sought to examine whether attentional bias as measured by i) percentage of first fixations, ii) percentage total dwell time, and iii) percentage of total fixations directed towards high muscle mass male bodies exists in a sample of men and women from the UK. Study 9 also sought to further ascertain whether this bias was stronger in those who internalise cultural body ideals, feel pressure to achieve such ideals and/or who possess a strong drive for muscularity, and whether any bias in visual attention can affect one's preferences for muscularity.

5.3.3.1. H1: There will be a bias in visual attention towards muscularity in male body stimuli

In line with Study 8 dot probe results, as well as prior research (e.g., Cho & Lee, 2013; Jin et al., 2018 and Talbot et al., 2019), the first hypothesis was supported as men and women both showed a bias in visual attention as measured by percentage dwell time *and* percentage total fixations directed towards high muscle mass males.

The percentage of first fixations directed towards high muscle mass males, however, differed between men and women. Specifically, women showed a bias in first fixations towards high muscle mass, whilst men did not. Thus, it seems that, for men at least, whilst they show an overall bias in attention towards high muscle mass male bodies (increased dwell time and increased number of fixations), their *initial* attention is not drawn to such bodies. Intra-sexual selection could explain this as, according to such evolutionary theory, muscular bodies are often perceived as threatening and dominant which can evoke feelings of intimidation and threat (Sell et al., 2009). This could thus explain why men would want to avoid looking towards dominant body types, at least initially. Indeed, Holland et al. (2017) found that most men (and women) rapidly avert gaze from the faces and upper bodies of others in dominant, non-verbal postures. Though, this does not explain why females did not also show initial gaze aversion to the more muscular bodies in Study 9. Further, findings revealed that overall, men do gaze at high muscle mass men longer than less muscular men and direct a higher number of fixations to these men too. So, whilst they are perhaps intimidated by high muscle mass male bodies at first and may show initial gaze aversion, they do eventually show curiosity in terms of their later gaze direction.

5.3.3.2. H2: Any bias in visual attention towards muscularity will be stronger in those men who internalise cultural body ideals, feel pressure to achieve such ideals and/or have high a high drive for muscularity as measured by the SATAQ-4 and DMS.

In line with Study 8, hypothesis 2 was also supported in Study 9 as findings showed that bias in visual attention towards high muscle mass male bodies was stronger in those men who had pre-existing body concerns and/or who internalised muscular body ideals. Specifically, in men, percentage dwell time towards high muscle mass males was positively related to increasing Internalisation-Muscular SATAQ-4 subscale scores, total DMS score, attitudinal DMS and behavioural DMS scores. In women, it was predicted by increasing Internalisation-Muscular SATAQ-4 subscale scores. This means that those men and women who internalise muscular body ideals themselves show an attentional bias towards muscular characteristics in the same (men) or opposite (women) sex.

In terms of percentage of first fixations towards high muscle mass males, this measure was positively correlated with the behavioural DMS component (for men), and negatively correlated with the 'Pressures-Peers' and 'Pressures-Media' SATAQ-4 subscale scores (for women). The negative correlation involving women's 'Pressures-Peers' scores and attentional bias was also reported in Study 8. Furthermore, these findings are, more generally, in line with previous research whereby high levels of weight/shape dissatisfaction in women was a negative predictor of preferences for attractive partners (Legenbauer et al., 2009). The findings for men are, like the findings of Study 8, consistent with previous muscularity bias research which has found that those men concerned with cultural body ideals have an attentional bias towards high muscle mass male bodies (Cho & Lee, 2013; Jin et al., 2018; Talbot et al., 2019).

Percentage of total fixations towards muscularity was not correlated with any of the SATAQ-4 or DMS measures for either men or women. This may be because number of fixations does not always directly correspond to attention (Holmqvist et al., 2011).

5.3.3.3. H3: Any bias in visual attention will subsequently lead to musculature preference changes in the direction of the image type one preferentially attends to

In terms of hypothesis 3, those who showed a bias in visual attention towards high muscle mass males (as measured by percentage of first fixations, total percentage dwell time, and percentage of total fixations) did not show an increase in their preferences for muscularity as would have been expected under the visual diet hypothesis, even when they had elevated internalisation of muscular ideals. This deviates from the dot probe study, which did find evidence of significant musculature preference changes in those men who strongly internalised the muscular body ideal. Study 9 findings are also, more generally, inconsistent with previous work that shows idealised body viewing can subsequently affect one's perceptions of such imagery (e.g., Brooks et al., 2020; Sturman et al., 2017 and Jacques, Evans & Boothroyd, 2021). The general discussion will further engage with the explanations as to why the current paper failed to show evidence for significant changes in musculature preferences amongst those who showed a bias in visual attention towards high muscle mass males.

5.3.4. General discussion

The primary purpose of this research was to explore whether UK men and women would show a bias in visual attention towards muscularity in male body stimuli, whether those who internalise cultural body ideals, feel strong pressures to achieve these ideals (as measured by the SATAQ-4) and/or possess pre-existing body image concerns related to muscularity (as measured by the DMS) are more susceptible to such a bias, as well as whether any bias in visual attention would subsequently lead to significant changes in one's musculature preferences in the direction of the image type one preferentially attends to. Both studies revealed that men and women do show an attentional bias towards high muscle mass males, and that internalisation of muscular body ideals (in men and women) and drive for muscularity (in men) can predict this bias. There was little evidence that such a bias in attention could significantly change one's preferences for muscularity in either study, with the exception of a group of men in Study 8 who had strongly internalised the muscular body ideal.

Findings suggest there is a clear visual bias towards high muscle mass male bodies in *both* men and women. It would make sense for men to show such a bias given that muscularity is something they aspire towards (Tiggemann, Martins & Kirkbride, 2007), with a large chest and small waist being the primary component of men's overall attractiveness as rated by other men (Swami & Tovée, 2008). Social comparison processes (Festinger, 1954) may also explain findings here as this proposes that men will identify with, preferentially focus upon, and compare themselves to, other males of a positive valence. For women, the bias towards high muscle mass male bodies may be due to women preferring high muscle mass male bodies to those with less muscle definition (e.g., endomorphs and ectomorphs) (Dixson et al., 2014), with women's perception of men's physical strength determining over 70% of his bodily attractiveness (Sell, Lukazsweski, & Townsley, 2017). This greater attraction towards men who possess higher muscle mass may explain why women preferentially look at these idealised male bodies more in Studies 8 and 9. Indeed, Ridley et al. (2022) found both men and women prefer high muscle mass, low adiposity bodies, and they found that this preference was stronger in those who had internalised the cultural ideal for muscularity. This latter finding is in line with findings of the current paper in that we, similarly, found both men and women who strongly internalise muscular body ideals experience *more* of a bias in visual attention towards high muscle mass male bodies than those who internalise less. This research is the first to show such a bias in visual attention in both men and women when they are presented with a mixture of high and low muscle mass male bodies.

With the exception of a group of men in Study 8 who had strongly internalised the muscular body ideal, Studies 8 and 9 failed to reveal evidence that such a bias in visual attention could significantly alter one's musculature preferences. A potential explanation for this is that, despite men and women showing a bias in visual attention towards muscularity, they were still viewing a combination of different image types (high vs low muscle mass bodies) on screen together for each trial and, as such, there may not have been a *sufficiently* biased enough visual experience in these image trials to induce any measurable musculature preference changes.

However, Stephen et al.'s (2018) used a similar stimulus presentation design to that used in Study 8 and they *did* induce significant shifts in body perceptions (specifically, body perceptions of normality), though in relation to fat mass rather than muscularity. Specifically, they found that attentional bias towards thin bodies (when presented with paired thin and large bodies) mediated the relationship between body satisfaction and susceptibility to the body size adaptation effect, such that those men and women who were most dissatisfied with their bodies, were more likely to preferentially attend to thin bodies and then showed shifts in their perception of a normal female body towards thinness as a result. Indeed, in Study 8, findings similarly revealed that men who had strongly internalised muscular body ideals experienced stronger shifts in their musculature preferences in comparison to those men who had internalised less, though this was not mediated by muscularity attentional bias scores.

Although men of Study 8 who had strongly internalised muscular body ideals showed stronger shifts in musculature preferences, no other aspects of internalisation of cultural body ideals or any DMS measures were found to predict this, nor was there any evidence for this amongst the participants of Study 9. One explanation for inconsistencies here is that the female participants in Stephen et al.'s (2018) study may have had more of a bias in terms of fixation duration and number of fixations towards thin bodies than the men in Study 9 did to muscularity thus explaining why they observed significant changes in body perception following image viewing amongst their body dissatisfied group and we did not (with the exception of men from Study 8 who strongly internalise the muscular body ideal). However, when comparing relative biases, the men of Study 9 actually showed *more* of a bias in visual attention directed towards high muscle mass males than the females of Stephen et al.'s (2018) study did towards idealised thin female bodies. Specifically, Stephen et al. (2018) reported that female participants directed a larger percentage of fixations (M=58.98, SD=15.38) and fixation duration (M=59.16, SD=16.11) towards idealised thin female body type than would be expected by chance. Whilst those men of Study 9, on average, directed a larger percentage of fixations (M=59.538, SD=8.254) and fixation duration (M=63.411, SD=10.235) towards idealised muscular male body types than would be expected by chance.

It was thus also considered that men of Study 8 and Study 9 may have differed in terms of their Internalisation-Muscular SATAQ-4 subscale scores which could explain why this measure was found to predict the strength of musculature preference changes amongst the men of Study 8 and not those men of Study 9. Indeed, the skewness of Internalisation-Muscular SATAQ-4 subscale scores for men in Study 8 was -.52, indicating the distribution was left skewed, with most men's Internalisation-Muscular SATAQ-4 subscale scores above the mean (M=17.714, SD=4.111). The skewness for those men of Study 9, however, was .22. (M=15.176, SD= 4.465). We must consider that these differences in the distribution of Internalisation-Muscular SATAQ-4 subscale scores could perhaps explain why this measure predicted how strong the change in one's musculature preferences was following image viewing amongst those in Study 8 and not Study 9.

A further reason why findings did *not* reveal internalisation of the muscular body ideal to predict the strength of one's changes in musculature preferences following image viewing amongst the men of Study 9 could be in relation to number of trials. Specifically, Study 9 only had 20 trials in the eye tracking phase of the study. The intention here was to ensure that participants would stay focused on the task and this design adhered to guidance on recommended duration of eye tracking studies. The limited number of trials in Study 9, however, could mean that there were not enough trials present to induce any preference changes despite a clear bias in visual attention towards muscularity amongst participants. Study 8, on the other hand, had 48 paired image trials making up the dot probe phase of the study and this could explain why there was *some* evidence (in men who strongly internalise muscular body ideals) of significant musculature preference changes following image viewing in this study.

A further explanation for the lack of evidence of musculature preference changes in Study 9 is in relation to stimulus presentation. Specifically, the way stimuli were presented on screen differed across the two studies. Not only were there fewer trials in Study 9 as previously mentioned, but the 20 trials of Study 9 were also made up of an array of six bodies (three high and three low muscle mass bodies), whilst the 48 trials of Study 8 were made up of paired images of a high and low muscle mass body. It could be that these paired images elicit *more* attentional bias towards muscularity in those men who strongly internalise muscular body ideals than is the case when such men view the 20 trials of Study 9. This may be because the paired images of Study 8 were larger on screen than each of the 6 images on screen in Study 9, and this may have elicited more bias. To explore whether differences in stimulus presentation can indeed affect interactions here, future research should seek to replicate Study 9 but using the paired image trials that make up Study 8.

In terms of further future work, whilst Studies 8 and 9 have studied bias in visual attention in men and women towards muscular *male* bodies, future work may seek to explore whether such a bias in visual attention exists in men and women who are viewing female bodies of high or low muscle mass. Such findings will allow us to establish whether a bias in visual attention is only apparent when sex-specific body traits, such as high muscularity, are assigned to the appropriate sex. Furthermore, replications may also consider the extent to which cultures vary in the emphasis they place on muscularity in men and women, specifically whether such attentional biases are evident in cultures which may value male muscularity less.

5.3.5. Conclusion

In summary, findings of Studies 8 and 9 show men and women show a bias in visual attention towards high muscle mass male bodies. These studies are the first of their kind to show such selective attention in both men and women. Further, findings show that those who internalise cultural body ideals (those men and women with high Internalisation-Muscular SATAQ-4 subscale scores, for example) are more likely to show an attentional bias towards high muscle mass bodies over those who internalise less, and those men experiencing attitudinal and behavioural drives for muscularity (as measured by DMS) also show a stronger attentional bias towards muscularity than those men with lower drives for muscularity. However, findings suggest that any bias in visual attention towards high muscularity only (sometimes) predicts shifts in muscularity preferences in the expected directions in those men who strongly internalise the muscular body ideal (see Study 8). Indeed, inconsistencies exist more generally within the research field itself and this highlights the need for further work into this neglected area to further ascertain when and how musculature visual diet effects can occur. Overall, findings suggest that attentional bias towards idealised (muscular) male bodies plays a role in the expression and perhaps maintenance of body concerns and internalisation of cultural body ideals in men.

Chapter 6.

General discussion

6.1. Results of this thesis

With most body preference and body image research focusing almost exclusively on female samples and body type preferences for BMI, the overarching aim of this thesis was to address a key gap in the literature by examining preferences for male muscularity and experimental manipulation of such preferences amongst men, women, boys and girls. Despite the assumption that men are less prone to the negative effects of Western media exposure, the findings of this thesis suggest otherwise. Specifically, findings of this thesis indicate that preferences for male muscularity in men, women, boys and girls can, much like one's preference for the thin body ideal in females, be affected by one's visual diet, and this may be creating and/or maintaining unrealistic male body standards.

The empirical components of this thesis are made up of nine studies, seven of which explored manipulation of one's male body musculature preferences (see Table 6.1 below for a summary of such work), with all but one of these revealing that preferences for male muscularity are indeed malleable in some or all of our samples. These studies also examined whether age, gender, drive for muscularity, internalisation of cultural body ideals, pressures to achieve such ideals and/or bias in visual attention towards muscularity could influence the extent of such preference changes. I additionally sought to build upon current developmental work by examining the developmental trajectory of SATAQ-4 and DMS scores, muscularity preferences and perceptions, as well as manipulation of musculature preferences amongst a group of 6-18-year-old boys and girls. Finally, using the dot probe paradigm and eye tracking, I sought to explore whether men and women showed a bias in visual attention towards high (over low) muscle mass male bodies and whether SATAQ-4 and/or DMS measures could predict the strength of this attentional bias.

To summarise the findings of this empirical work, with the exception of Study 9, the findings of those studies exploring experimental manipulation of musculature preferences presented in this thesis are in line with previous similar work by Brooks et al. (2020a) and Sturman et al. (2017) who found that participants' perceptions of normal levels of muscularity increased (decreased) after viewing high (low) muscle mass bodies. The studies presented in the empirical chapters of this thesis similarly showed that participants' *preferences* for muscularity increased (decreased) after viewing images of high (low) muscle mass male bodies.

The work presented goes beyond previous body perception manipulation work in that it provides evidence that visual diet (men and women) and associative learning (men only) mechanisms can both underpin such shifts in musculature preferences (Studies 1 and 2). Study 3 is also the first study of its kind to show that, even when manipulation imagery is less obviously skewed towards a particular body type, preferences can still shift towards the most prevalent body type. Study 4 built upon the existing male body preference work by revealing that men with high total SATAQ-4 scores and/or Pressures-Peers SATAQ-4 subscale scores showed stronger musculature preference changes following image viewing in comparison to those who scored lower on such measures. Study 5 examined the developmental trajectory of SATAQ-4 and DMS scores, with findings revealing that amongst 11-18-year-olds, Internalisation-Muscularity SATAQ-4 subscale scores (in girls and boys) and DMS scores (in boys) increased with age. Study 6 was the first musculature preference change study to be carried out with child and adolescent groups. Findings revealed that preferences for muscular male body types increased with age, and there was evidence of significant shifts in musculature preferences following manipulation image viewing amongst the three-hundred-and-ninety-four 6-18-year-old boys and girls who took part in Study 6. Notably, however, it was only the 15-18-year-old boys who showed evidence of this when data was broken down by gender and age. Study 7 revealed that across the different age groups boys and girls described high (low) muscle mass media figures in similar ways. Study 8 used the dot probe paradigm to show that both men and women visually attend to high muscle mass male bodies over low muscle mass male bodies as measured by their reaction times to a dot that appeared in place of one of the two body types. Total SATAQ-4 scores, Pressures-Peers and Pressures-Media SATAQ-4 subscale scores (men only) and Internalisation-Muscular SATAQ-4 subscale scores (women only) positively predicted muscularity bias scores, with Pressures-Peers and Pressures-Family (women only) negatively predicting muscularity bias scores. Men in Study 8 with high Internalisation-Muscular SATAQ-4 scores showed stronger changes in musculature preferences following image viewing than those with lower Internalisation-Muscular scores. Finally, in line with Study 8 findings, Study 9 also revealed an attentional bias towards high muscle mass male bodies as measured by percentage dwell time and number of fixations directed towards high muscle mass males (men and women) and percentage of first fixation directed towards high muscle mass males (women only). For Study 9, Internalisation-Muscular SATAQ-4 subscale scores (men and women), and DMS (both attitudinal and behavioural component) scores (men only) positively predicted percentage dwell time directed towards high muscle mass male bodies. For first fixations directed towards high muscle mass bodies, this was positively predicted by the behavioural DMS component for men, and negatively predicted by the Pressures-Peers and Pressures-Media SATAQ-4 subscale components for women.

Notably, the findings regarding SATAQ-4 measures as potential predictors of how strong one's musculature preference changes are amongst men (Studies 4 and 8) are not consistent across the body preference manipulation work presented in this thesis and thus one must be cautious with interpretation. Indeed, this is an area that later sections of this chapter will engage with in more depth. Overall, the empirical work presented in this thesis builds upon the current male body image and body preference literature and suggests male body preferences, much like female body preferences, can too be influenced by one's visual diet. The empirical work also provides evidence, albeit inconsistent, of some potential individual differences with regards to how easily manipulated one's preferences for muscularity can be, which future work should build upon.

6.1.1. Manipulating male musculature preferences

6.1.1.1. Summary of experimental manipulation of musculature preference findings

Table 6.1 below provides a summary of the seven studies that examined changes in preferences for muscularity (Studies 1, 2, 3, 4, 6, 8 and 9), with all but one (Study 9) of these revealing evidence for significant changes in such preferences following image viewing. Specifically, this work has shown that when participants viewed images of high (low) muscle mass males, this increased (decreased) their preferences for muscularity, indicating that male body muscularity preferences are malleable in men, women, boys and girls.

This work builds upon the current body perception manipulation work (e.g., Sturman et al., 2017 and Brooks et al., 2020a) in several ways. For example, unlike this previous work which has only explored whether viewing manipulation stimuli can shift '*perceptions of normality*' in relation to levels of muscularity, the studies I present alternatively measured shifts in *preferences* for muscularity following image viewing. This is an important area of study given that it has been assumed that if one's perception of normality shifts towards a higher level of muscularity, this could create unrealistic body standards for men. In Chapter 1 it is argued that such claims may be somewhat presumptive. Whilst perceptions of normality and preferences for certain body types are likely anchored towards similar prototypes, they will not necessarily be the same. Whilst it seems plausible that one would want their body to be in line with, or perhaps be better than, what they perceive to be a normal body, it is also possible for someone to feel a high muscle mass body looks normal and yet, not prefer that body type over a less muscular alternative and, as such, have no desire to achieve such a body type. Specifically, just because one's perception of normality shifts towards a more muscular body type, does not necessarily mean this will negatively impact their body image as per some of the claims of previous work. My empirical work, however, has confirmed that viewing high (low) muscle mass male bodies does increase (decrease) one's preference for male muscularity. When viewed alongside the findings of existing studies exploring manipulation of musculature perceptions, this shows that there is *both* a shift in one's perception of normality *and* a shift in one's preference for muscularity following image viewing. If a male thinks a high muscle mass body is 'normal' *and* prefers this body type over less muscular alternatives, one could argue it is very likely that this is going to negatively impact his body image, at least in those males who do not possess such levels of muscularity themselves.

Additionally, the musculature preference manipulation work presented in this thesis goes beyond previous studies by showing that both visual diet and associative learning mechanisms can underpin musculature preference shifts. Specifically, viewing low muscle mass male bodies decreased men and women's preferences for male muscularity irrespective of image valence, and viewing positive valence low muscle mass male bodies could decrease men's preferences for muscularity when presented alongside an equal number of neutral high muscle mass male bodies. High muscle mass male bodies increased one's preferences for muscularity but *only* when these images were of a positive valence, with such findings suggesting that Western media's promotion of high-status, positive valence, muscular males is likely to be increasing one's personal preferences for male muscularity creating unrealistic standards of the male body.

Table 6. 1

A summary of each of the musculature preference manipulation studies making up the empirical components of this thesis.

Study number	N	Stimuli	Evidence for manipulation of musculature preferences ?	Do SATAQ-4 and/or DMS measures influence the strength of musculature preference changes?	
				SATAQ-4	DMS
1	190 (74 men and 116 women)	pp viewed and indicated their preferences for: -**50 photos** of aspirational high muscle OR -**50 photos** of aspirational low muscle OR -**48 photos** of neutral high muscle mass OR -**48 photos** of neutral low muscle mass male bodies	Yes	N/A	No
2	84 (31 men and 53 women)	pp viewed and indicated their preferences for: -**24 photos** of aspirational high muscle mass *and* **24 photos** of neutral low muscle mass male bodies OR - **24 photos** of aspirational low muscle mass *and* **24 photos** of neutral high muscle mass male bodies	Yes	N/A	No
3	84 (45 men and 39 women)	pp viewed and indicated their preferences for: - **48 (38 photos and 10 CGI)** high muscle mass *and* **22 (16 photos and 6 CGI)** low muscle mass OR -**48 (38 photos and 10 CGI)** low muscle mass images *and* **22 (16 photos and 6 CGI)** high muscle mass male images.	Yes	N/A	N/A
4	165 (80 men, 84 women, 1 'other'	Pp viewed and indicated their preferences for: - **48 (24 photos and 24 CGI)** low muscle OR -**48 (24 photos and 24 CGI)** high muscle mass male bodies	Yes	Yes – Men's total scores and Pressures-Peers subscale	N/A
6	394 (243 boys, 151 girls)	204 pp (Sample 1) viewed and indicated their preferences for **24 CGI images and 24 photographs** of high or low muscle mass bodies. All other pp (Samples 2 & 3) viewed and indicated their preferences for **48 photographs** of either high or low muscle mass bodies	Yes	No	No
8	186 (56 men, 129 women, 1 'non-binary'	pp freely viewed **48 pairs of CGI images** where one body from each pair was of high muscle mass, and the other was of low muscle mass bodies	Yes	Yes- Men's Internalisation-Muscular subscale scores	No
9	97 (42 men, 55 women	Participants freely viewed **20 trials where, for each trial, an array of 6 CGI images** (3 high muscle mass and 3 low muscle mass) were presented together on screen.	No	No	No

Furthermore, because previous body perception manipulation literature has been criticised for the potential confound of demand characteristics i.e., participants discerning the intention of the study and consciously shaping their responses in line with this, Study 3 was designed, as the first study of its kind, to test whether significant musculature preference changes can still be observed when manipulation image bias towards a particular body type is more subtle. 'Distractor images' were presented alongside idealised manipulation images of bodies to lessen the likelihood of demand characteristics acting as a confound. Here, findings revealed that if high muscle mass male bodies made up the *majority* of one's visual diet (even if a very subtle majority), musculature preferences *still* increased as a result. Findings suggest that even when Western media presents a range of male bodies varying in their body type, if the *majority* of these body types are high in muscle mass, this can still increase personal preferences for male muscularity which could also contribute to one's unrealistic male body standards.

Finally, the musculature preference manipulation studies presented in this thesis build upon previous work by examining the potential individual differences that could predict the strength of any musculature preference shifts following manipulation image viewing, exploring, for the first time, whether such preference shifts can be observed in in a group of 6-18-year-old boys and girls, and whether age, SATAQ-4 and/or DMS scores can influence the strength of any such preference shifts. The later sections of this chapter will engage with whether any of these measures are indeed valid moderators of musculature preference changes. Overall, findings have implications in that they suggest that Western media's depiction of idealised male bodies may be contributing to, or at least be maintaining, the unrealistic standards of the male body in men, women, boys and girls.

6.1.1.2. Why was there no evidence of significant changes in musculature preferences amongst those in Study 9?

As discussed in Chapter 5, deviating from the findings of the six other musculature preference manipulation studies, Study 9 (the eye tracking study) revealed no evidence of any significant changes in one's musculature preferences following image viewing. However, as outlined in Chapter 5, this lack of evidence is likely down to flaws with the stimulus presentation design of Study 9. Specifically, there were only 20 trials making up the manipulation phase of the study, such as to not exceed the maximum recommended duration of an eye tracking study of this kind. For all other studies described in the empirical chapters of this thesis, which *did* all reveal some evidence of shifts in musculature preferences, there were between 48 and 50 manipulation trials used. As such the lower number of trials in Study 9 could have meant there was not sufficient enough of a bias in visual experience to induce any preference changes, despite a clear bias in attention towards high muscle mass males amongst Study 9 participants.

6.1.1.3 Who is more prone to musculature preference changes following image viewing?

Given that previous work in the body size dimension has revealed that those who are most concerned with their bodies are more likely than those who are body satisfied to show significant shifts in perceptions (body normality and preferences) following manipulation image viewing (e.g., Glauert et al., 2009 and Stephen et al., 2018, although cf. Boothroyd, Tovée & Pollet, 2012), I similarly sought to examine whether SATAQ-4 and/or DMS scores could induce stronger shifts in musculature preferences following image viewing. Knowing which males are more vulnerable to such body preference changes has useful implications as this will allow interventions that aim to reduce the negative impact of idealised Western media imagery to be best be targeted at these vulnerable individuals in an attempt to alleviate any body concerns they may possess. The findings of Studies 4, 6 and 8 revealed that certain individuals may, indeed, be more vulnerable to stronger musculature preference shifts over others. For example, in terms of SATAQ-4 measures, those men with high total SATAQ-4 scores and/or high Pressures-Peers (Study 4), or high Internalisation-Muscular SATAQ-4 subscale scores (Study 8) were more likely than those men with lower scores to experience shifts in their preferences for muscularity in the predicted directions following image viewing.

However, as outlined in Table 6.1, whilst I present two studies that show some of the SATAQ-4 measures can predict the strength of any musculature preference changes (Studies 4 and 8), these studies do not show the *same* SATAQ-4 measures to predict susceptibility. Additionally, I present two other studies as part of this thesis that also collected SATAQ-4 responses yet failed to reveal evidence for *any* of the SATAQ-4 measures predicting the strength of musculature preference changes (Studies 6 and 9). This thus highlights some crucial inconsistencies within the body of work, posing doubt over whether such SATAQ-4 measures are valid moderators of musculature preference changes. Furthermore, I note that *none* of the DMS measures predicted the strength of such body preference changes in any of the studies it was measured in (Studies 1, 2, 6, 8 and 9) as presented in Table 6.1.

One explanation for the lack of evidence that DMS scores can predict the strength of musculature preference changes is that those with high DMS scores may not necessarily be paying more attention to the high muscle mass male bodies presented as part of the manipulation trials, thus lessening the likelihood of musculature preference changes being observed in this group. However, it could be argued that this is unlikely given that current evidence from eye tracking (Cho & Lee, 2013), compound visual search tasks (Talbot et al., 2019) and dot probe paradigm studies (Jin et al., 2018) has shown that men's attentional bias towards muscularity is stronger in those who are dissatisfied with their bodies. Furthermore, the attentional bias evidence making up the empirical component of this thesis similarly showed that men with high DMS and/or high attitudinal and/or high behavioural DMS subcomponent scores, did spend *more* time looking at high muscle mass male bodies (as measured by the total percentage dwell time directed towards high muscle mass male bodies) than those who scored lower on such measures (Study 9). It could therefore be the case that DMS, whilst predicting attentional bias towards high muscle mass male bodies, simply does *not* predict the strength of changes in preferences for muscularity following image viewing, perhaps because it is only one's body dissatisfaction (not their drive for muscularity) that predicts this. Indeed, the existing body perception literature has *only* found *body dissatisfaction* specifically to enhance susceptibility to body size visual diet effects (e.g., Glauert et al., 2009; Stephen et al., 2018). Having a high drive for muscularity does not necessarily mean that one is dissatisfied with their body as one can be close to their muscular body ideal, and be satisfied with their body, yet still have a desire to gain *more* muscle mass. Further, whilst some research has suggested a relationship between body dissatisfaction and drive for muscularity (e.g., Bucchianeri et al., 2014; Liu et al., 2019), the relationship is thought to be complex. For example, Bucchianeri et al. (2014) found that having a strong tendency to compare oneself with others was found to exacerbate the relationship between men's body dissatisfaction and their drive for muscularity. Moreover, Bergeron and Tylka (2007) conclude that muscularity body dissatisfaction and drive for muscularity have common characteristics but are not identical constructs, and Stratton et al. (2015) found that muscle dissatisfaction was *not* significantly related to drive for muscularity behaviours. It may therefore be the case that body dissatisfaction in men can predict the strength of musculature preference changes, yet one's drive for muscularity on its own cannot.

One explanation for the inconsistencies regarding which SATAQ-4 subscales predicted visual diet effects in Studies 4 and 8 could possibly be due to the fact that the existing work examining body perception manipulation has *only* revealed body dissatisfaction to enhance one's susceptibility to body size visual diet effects (e.g., Glauert et al., 2009; Stephen et al., 2018), and, as previously mentioned, it could be that body dissatisfaction is the true moderator of of visual diet effects and this construct is only sometimes associated with certain SATAQ-4 measures in some individuals. For example, You and Shin (2020) found that peer and media pressures in Korean men had significant direct relationships with body dissatisfaction, as well as indirect relationships with body dissatisfaction via the drive for muscularity. Such findings could explain why Pressure-Peers was the only SATAQ-4 subscale measure to predict susceptibility to visual diet effects in Study 4, yet it does not explain why the Pressures-Media SATAQ-4 subscale did not also predict susceptibility in Study 4, nor does it explain why such measures did not predict susceptibility in any of the other studies. Study 8 findings, instead, revealed that higher Internalisation-Muscular SATAQ-4 subscale scores enhanced susceptibility to musculature visual diet effects in men. Indeed, a recent review revealed a significant positive relationship between men's internalisation of the muscular body ideal and body dissatisfaction (Paterna et al., 2021). On the basis of these inconsistent results regarding susceptibilities, an integral direction for future research, as will be discussed in the later sections of this chapter, is to measure male participant's body dissatisfaction in future body visual diet effect work to examine whether this construct can predict susceptibility more reliably than the SATAQ-4 measures.

A further explanation for inconsistencies as to which SATAQ-4 measures predict susceptibility to visual diet effects in men is in relation to methodological differences across the studies. For example, for Study 8, where Internalisation-Muscular SATAQ-4 subscale scores predicted susceptibility in men, participants were asked to freely view 48 paired images of high and low muscle mass CGI bodies. Whereas for Study 4, where total SATAQ-4 scores and the Pressures-Peers subscale scores predicted susceptibility in men, participants were shown 48 individual images (24 photographs and 24 CGI images) and had to compare each one to the one previously seen indicating which they preferred. The two very different tasks, and different stimuli used in each of the two studies, could explain inconsistencies in results. For example, the real photographs that made up half of the manipulation stimuli in Study 4 could arguably induce more social comparison than the equivalent CGI images (used for all of Study 8 trials) because they depict *real* men. This could explain why perceived pressures from peers predicted susceptibility to visual diet effects in Study 4 but not 8 as one would expect those who feel body pressures from peers to be more likely to compare themselves to those with desirable bodies who they identify with (i.e., those real high muscle mass males depicted in the manipulation images). On the basis of these inconsistencies, I argue that there is an undeniable need for more research into this vastly neglected field such that we can better understand which men, if any, are particularly vulnerable to the negative effects of idealised body exposure. Indeed, the latter parts of this chapter will make recommendations as to how future work can build upon the current body of work that is presented in this thesis.

Whilst the DMS measures and some of the SATAQ-4 components did not predict susceptibility to visual diet effects in any of the musculature preference manipulation studies, some of these measures *did* predict greater visual bias in attention towards high muscle mass male bodies. For example, Internalisation-Muscular SATAQ-4 subscale scores, Total DMS and attitudinal and behavioural DMS scores all positively predicted percentage dwell time towards high muscle mass males amongst men in Study 9 (though this may not necessarily impact their later preferences for such body types given the lack of evidence for visual diet effects in Study 9). However, as previously noted, it could be that there were not enough eye tracking trials to induce any visual diet effects here.

Furthermore, it could be that the relationship is more complex in that one's SATAQ-4 and DMS scores may predict greater visual attention towards muscularity but perhaps this *only* predicts heightened susceptibility to visual diet effects in those who are already dissatisfied with their bodies. Equivalent work has shown that visual attention mediates the relationship between body satisfaction and susceptibility to the body size adaptation effect (Stephen et al., 2018)

Study 6 revealed an additional susceptibility to body visual diet effects: age. Specifically, Study 6 findings revealed that viewing high muscle mass male bodies increased one's preferences for muscularity, although it was only the older 15-18-year-old boys who showed this effect when data was broken down by gender and age. This is a novel finding given that there currently exists no published work exploring experimental manipulation of musculature preferences amongst young children, nor is there research exploring how susceptibility to such effects may be stronger in older children, than in younger. Age did not predict susceptibility to body visual diet effects in girls of Study 6.

6.1.1.4. Implications of the musculature preference manipulation work

The fact that every study described in the empirical component of this thesis, at some level, provided evidence for musculature preferences shifting as following body exposure (with the exception of Study 9) has important implications: This work suggests that Western media depicting unrealistic, often unattainable, bodies of men, may be contributing to, or at least be maintaining, the unrealistic standards of the male body in men, women, girls and boys. This work suggests that males, much like females, can also experience shifts in body shape preferences based on their visual diet and, as such, we should be working towards ways in which we can promote more realistic body standards for males to prevent body image issues in those who fail to achieve these unrealistic body standards. It should also be noted that certain individuals may be more susceptible to visual diet effects, though there are inconsistencies within the body of work presented as to what these susceptibilities may be. This therefore highlights the need for future research into this neglected field such as to better understand the complexities of any potential susceptibilities.

6.1.2. Gender differences

Within the empirical work presented, several gender differences were discovered in terms of visual diet effects. Whilst most studies revealed manipulation of musculature preferences could be observed in *both* male *and* female participants, findings of Studies 2 and 6 showed that men (Study 2) and older boys (Study 6) could be more susceptible to such preference shifts following manipulation image viewing compared to females. Specifically, Study 2 findings revealed a significant interaction between phase, condition and gender, with *only* men showing evidence for associative learning mechanisms underpinning their changes in musculature preferences. For Study 6, there was a significant interaction between phase, condition, gender and age, such that boys were more susceptible to visual diet effects with increasing age, whilst girls did not show such an effect. Indeed, this is in line with previous work manipulating perceptions of muscularity, which has shown such effects to be stronger when participants view stimuli that are the same gender as them (Brooks et al., 2020a). As outlined in Chapter 2 and 4, such gender differences could be explained via social comparison processes (Festinger, 1954), whereby one identifies with, preferentially focuses upon, and compares themselves to, other targets of a positive valence. Whilst both males and females engage in social comparisons, it is males who are most likely to compare themselves to the *male* targets presented as stimuli in the studies. Specifically, in Study 2 men may have preferentially focused on the positively valenced, over the neutral, male targets, explaining why their preferences shifted in the direction of these aspirational/ positive valence manipulation images, whilst for women, who are less likely to identify with male targets, such significant musculature preference shifts did not occur. Furthermore, given that Study 6 stimuli were made up of young adult *male* body stimuli, social comparison theory would predict that the older boys (over younger boys and the female participants) would spend a longer time attending to such images, comparing themselves to them, thus explaining why musculature preference changes were more pronounced for the older boys specifically.

For Study 4, a further gender difference emerged; whilst both men and women showed evidence of musculature preference changes following manipulation image viewing, it was only men's high SATAQ-4 scores (total and Pressures-Peers subscale scores) that enhanced susceptibility to such visual diet effects, not women's. Again, such findings are not surprising given that the manipulation images were made up solely of male bodies, which women would be less likely to identify with, and, as such, even if women strongly internalised cultural body ideals and experienced increased pressure to achieve such ideals, they would not necessarily be expected to pay more attention to such muscular male imagery and thus would not be more susceptible to visual diet effects over women who are low SATAQ-4 scorers.

In Study 8, only female data revealed a significant interaction between phase and muscularity bias scores, though this was not in the expected direction. Specifically, women with higher muscularity bias scores showed a smaller increase in their preferences for muscularity post-dot-probe task than those who had lower muscularity bias scores. Further, whilst there was no significant two-way interaction between phase and muscularity bias scores for men, there was a significant interaction between phase, condition and Internalisation-Muscular SATAQ-4 subscale scores for men, but not women, such that those men with higher Internalisation-Muscular SATAQ-4 scores were more susceptible to visual diet effects in the expected directions than those men with lower subscale scores. There were no further gender differences in terms of the findings related to manipulation of musculature preferences.

Aside from the gender differences related to manipulation of musculature preferences, there were some additional gender differences that emerged within the empirical work. For example, in Study 5, whilst both boys' and girls' Internalisation-Muscular SATAQ-4 scores increased with age, it was only boys' DMS scores that increased with age. This is unsurprising given that muscularity is thought to be a key aspect of male body image specifically. Further, for men in Study 8, total SATAQ-4, Pressure-Peers, and Pressures-Media SATAQ-4 subscale scores positively predicted muscularity bias scores, with the relationship between Internalisation-Muscular SATAQ-4 subscale scores and muscularity bias scores in men approaching significance (p=.053). For women, muscularity bias scores were positively predicted by Internalisation-Muscular SATAQ-4 scores, and negatively predicted by Pressures-Peers and Pressures-Family SATAQ-4 scores. Chapter 5 has engaged with the potential explanations for such gender differences in these relationships. An additional gender difference emerged in Study 9; whilst both men and women showed attentional bias towards muscularity in terms of number of fixations and percentage dwell time directed towards high muscle mass male bodies, it was *only* women who showed an attentional bias towards high muscle mass males in terms of first fixations. As discussed in Chapter 5, one could argue this may be because high muscle mass males are perceived as threatening and dominant rivals to men which can evoke feelings of intimidation and threat, explaining why, at least initially men avert their gaze from other men with such bodies. Finally, men's percentage dwell time directed towards high muscle mass bodies was predicted by Internalisation-Muscular SATAQ-4 and DMS (attitudinal and behaviour subcomponents) scores, whilst for women it was predicted only by Internalisation-Muscular SATAQ-4 subscale scores. For percentage of first fixations directed toward high muscle mass males, the behavioural DMS subcomponent positively predicted this bias in men, and it was negatively predicted by the Pressures-Peers and Pressures-Media SATAQ-4 subscale scores in women. Again, Chapter 5 engages with the potential reasons for such gender differences.

6.2. Future directions

6.2.1. Cultural differences

This thesis has focused on muscularity preferences and manipulation of such preferences in Western cultures. All those who participated in the studies making up the empirical chapters of this thesis were men, women, boys and girls from the UK. An implication of this is that the findings presented here cannot be generalised to non-WEIRD (Western, Educated, Industrialized, Rich, Democratic) populations. Indeed, a review by Ricciardelli et al. (2007b) highlighted the limited nature of cross-cultural male body image research. In relation to cross-cultural work on body change strategies to increase muscle mass, for example, authors state that because there are so few studies examining differences in this area, it would be inappropriate to draw any conclusions.

There is some evidence to suggest that muscularity may be less important to certain cultures over others. For example, Jung, Forbes and Chan (2010) reported that, in comparison to a sample of US undergraduates, Hong Kong undergraduates selected less muscular bodies to represent their actual bodies, their ideal body, the body they believed other men would desire, and the body they thought represented what women would desire in their partners. They also scored lower in terms of their drive for muscularity, associated fewer positive traits with high muscularity, and reported higher body satisfaction in relation to their muscle mass than did the US participants. Interestingly, Cheng et al. (2016) studied Asian undergraduates who were living in the US and found these men may have a higher drive for muscularity due to acculturation to Western body ideals. Moreover, Frederick et al. (2007) highlighted some further cultural differences between US, Ghanian and Ukrainian men and their drive for muscularity. They found that over 90% of U.S. undergraduate men wanted to be more muscular, which was more than the proportion of Ukrainian (69%) and Ghanaian (49%) men who wanted this. Authors state that such cultural differences may be due to differences in the men's actual levels of muscularity and argue that those in the Ghanaian sample were typically more muscular than most US college students and thus may have already have achieved their desired level of muscularity, explaining why less of them desired more muscularity. Authors also argue that differences in exposure to Western body ideals, for example, via those body ideals depicted in Western Media, may, too, explain such cultural differences.

Indeed, more recently, cross-cultural work has suggested that the increasing accessibility of Western media, and its portrayal of unrealistic body standards may, to some extent, explain why body dissatisfaction is increasing in men worldwide, with more TV viewing and greater media internalisation associated with low body appreciation and a more muscular body ideal amongst men from *both* WEIRD and non-WEIRD populations (Thornborrow et al., 2020). However, this work has not examined whether musculature preferences can be experimentally manipulated in such groups. Such cross-cultural work therefore warrants further investigation, and, specifically, an important consideration for future research is to explore whether the findings of the studies described in the empirical chapters of this thesis can be replicated with non-Western samples, perhaps with those samples who are thought to value male muscularity less than Western groups.

6.2.2. Duration of musculature visual diet effects

A general problem with the literature examining changes in perceptions of bodies following manipulation image viewing is that most of these studies focus on brief exposures to various stimuli under laboratory conditions and the duration of any aftereffects are often not measured. Bould et al. (2020) have shown that perceptual after-effects in the body fat dimension could be fairly long-lasting, reporting that repeat exposures (5 minutes, twice a day for a week) to underweight (overweight) female bodies can result in women subsequently viewing more of the test stimuli as overweight (underweight) when tested the day after their last exposure. However, this work has focused on women and perceptual changes in the body fat dimension, with duration of musculature preference changes in men (and women) as a result of the visual diet effect remaining unstudied.

One of the key aims of this thesis was to explore how idealised bodies portrayed in Western media could be intensifying or, at least, maintaining unrealistic male body standards in men, women, boys and girls. The empirical work in this thesis shows that male muscularity preferences of individuals viewing high (low) muscle mass male bodies increased (decreased) as a result of this image exposure. Duration of musculature preference shifts was not focused upon within the body of empirical work presented because individuals living in the UK are so heavily engaged with Western media and its frequent depiction of idealised bodies as part of their everyday visual diet that it is this kind of persistent exposure over time that is likely to be maintaining the unrealistic male body standards in those who view such images. Specifically, if we can induce musculature preference shifts in the short-term using media imagery stimuli like those used under Studies 1, 2 and 6, then we know that repeated frequent exposure to Western media where such body ideals prevail is likely maintaining such preferences overtime. If we were to study long-term duration of musculature preference shifts this would prove to be a challenge as it is difficult to control for one's media use outside of the lab between the measuring of visual diet effects at timepoint 1 and timepoint 2 and such media use could confound results of visual diet effects observed at timepoint 2. Whilst this means it may be unrealistic to measure whether visual diet effects can last for days, weeks, or longer, future work *could* still explore whether visual diet effects can last up to an hour which would still be closing a gap in the literature. This is a more realistic duration for which participants can be asked to stay in the lab following the manipulation phase to complete a distractor task as a means to prevent media use between measuring preferences at timepoint 1 and timepoint 2.

6.2.3. Manipulating muscularity preferences using female body stimuli

Whilst the work presented in this thesis provides evidence of musculature preference shifts in response to viewing male body stimuli, future research may seek to replicate these studies using *female* body stimuli that varies in muscle mass. The muscular body ideal, whilst important to men, is becoming an increasingly important part of women's body image too (e.g., Gruber, 2007). Whilst previous studies have used both male *and* female body stimuli varying in muscle mass, only Brooks et al. (2020a) explored gender differences specifically. Authors analysed the responses of those participating in the Sturman et al. (2017) study and also recruited additional participants such that the total sample was made up of 64 men and 64 women. This analysis revealed that musculature (and fat mass) visual diet after-effects were stronger when participants viewed body stimuli that matched their own gender. However, this is the *only* study to explore such gender differences, and thus replications are crucial as they would allow us to further ascertain whether musculature visual diet effects are more sex-specific or can transfer to female body stimuli too.

6.2.4. Further consideration regarding stimuli for future studies

A further consideration for future work is whether CGI or photographs should be used as manipulation stimuli. The musculature perception shift studies presented within the empirical chapters of this thesis involved manipulation trials made up of solely CGI (e.g., Studies 8 and 9), solely photographs (Studies 1, 2, 3, and Samples 2 and 3 of Study 6) or a mixture of the two (Study 4 and Sample 1 of Study 6). Both CGI and photograph stimuli were shown to be capable of producing significant shifts in one's musculature preferences, with benefits and drawbacks of each stimulus type. For example, when creating the CGI stimuli, I was able to control height, face, skin tone, and fat mass of the body and thus stimuli varied *only* on the muscularity measure. The CGI images were also very realistic looking. However, such images do not represent the variety of idealised muscular male bodies depicted in Western media. Specifically, whilst many of these idealised male media figures may share the muscular physique, they will also possess other features that likely differ from one another e.g., facial features, skin tone, height etc. I therefore also created manipulation trials which utilised photographs of men, some of which were media figures, and some who were members of the public, but who all were pre-rated as being either high or low muscle mass. An interesting area for future investigation would be to explore whether perceptual shifts can be observed when CGI images are less realistic, mimicking perhaps the unrealistic, unhealthily proportioned male body types that often prevail in children's cartoons for example (González et al., 2020), as this would allow us to examine whether visual diet effects are limited to realistic images that one is perhaps better able to identify with.

Whilst the stimuli used in the empirical components of this thesis were pre-rated for muscularity, such judgements can be somewhat subjective and therefore future work may seek to use photographs of men who are required to visit the lab such that we can measure their muscle mass in more objective ways. For example, we could measure their fat-free mass index (FFMI) (Kouri et al., 1995), though authors note that this calculation will only provide a valid estimate of one's muscularity in those men who have low or moderate body fat. Future work may, alternatively, use Bioelectrical Impedance Analysis (BIA) as a way of measuring the muscle mass of those subjects whose bodies are photographed and used as manipulation stimuli. BIA provides a cross-validated (with magnetic resonance imaging) estimate of one's skeletal muscle mass in those of varying age and adiposity (Janssen et al. 2000). Measuring muscle mass of the bodies used as stimuli in this way would allow future research to measure the impact of differing levels of muscularity. For example, one would be able to examine the minimum level of muscularity needed to induce musculature visual diet effects.

All stimuli used in the empirical work of this thesis, whilst varying in muscle mass, were all low adiposity males. Male body image is a complex area of study in that men face dual pressures; a desire to be muscular but also to have low body fat in conjunction with this. Thus, future research may seek to explore manipulation of body preferences along both the muscle mass and fat mass axis. Indeed, as previously mentioned, Sturman et al (2017) and Brooks et al. (2020a) concluded that exposure to bodies along muscular and adiposity axes shifted perceptions of normality for muscularity or body fat respectively, suggesting that muscularity and adiposity are encoded by dissociable mechanisms. However, to our knowledge these are the *only* two studies exploring this, and in neither did researchers attempt to explore whether internalisation of cultural body ideals (thin and muscular ideals, for example), or any body dissatisfaction measure, could predict susceptibility to such visual diet effects, nor did they measure shifts in *preferences* for body fat and muscularity specifically Thus, this may be an interesting area for future research to explore.

6.2.5. Do visual diet effects transfer across identities?

Whilst the empirical work presented in this thesis suggests that viewing high (low) muscle mass male bodies can increase (decrease) one's preferences for muscularity, this work *only* measured one's preferences for muscularity in the bodies of *others*. As briefly noted in Chapter 1, we know that, for women at least, body size shifts in perceptions of normality can be transferred across identities of body manipulation and test stimuli. For example, thin (fat) manipulation stimuli that are either images of one's self or of others can *both* subsequently result in women perceiving their own bodies and other's bodies as larger (smaller) in size (Brooks et al. 2016). Though, Brooks and colleagues note that such effects were larger when manipulation and testing stimuli were of the same body type (e.g., both images of one's self). Notably though, Bould et al. (2020) found that exposure to manipulation images of other women who were either thin or large subsequently altered participants' perceptions of others' bodies, but did not alter perception of participants' own body size. Perhaps, therefore, an interesting direction for future research is to explore whether musculature visual diet effects can be transferred across identities. If we can show that viewing high muscle mass bodies can lead to underestimation of muscularity of one's own body, for example, this will add further support to the notion that Western media's portrayal of idealised high muscle mass bodies could be creating unrealistic standards of the male body and this could be increasing body image disturbance in men.

6.2.6. Examining susceptibilities to musculature visual diet effects

One further consideration for future work is to further examine whether there are any individual differences that may predict one's susceptibility to musculature visual diet effects. This chapter has already highlighted the inconsistencies within the empirical work regarding which SATAQ-4 measures may or may not enhance men's susceptibility to such effects. It has also been speculated that one's body dissatisfaction may be the true moderator of musculature visual diet effects, given that equivalent work that presents stimuli of differing fat mass has shown body dissatisfaction to predict susceptibility to the body size adaptation effect (e.g., Glauert et al., 2009; Stephen et al., 2018). Therefore, future work may, like Stephen et al. (2018) for example, assess participants' body satisfaction to explore whether this can predict the strength of any shifts in musculature preferences following the viewing of manipulation images.

6.3. Conclusion

Overall, this thesis has demonstrated that preferences for male muscularity amongst men, women, boys and girls, are malleable and can shift in response to one's visual diet. Specifically, preferences for male muscularity increase (decrease) as a consequence of viewing high (low) muscle mass male bodies. When presented alongside low muscle mass equivalents, it is the males of higher muscle mass that capture the attention of both men and women. This preoccupation with male muscularity appears to develop during childhood, with a child's age positively predicting increases in preferences for male muscularity (in girls and boys), internalisation of the muscular body ideal (in girls and boys) and drive for muscularity (in boys).

The empirical work presented has important implications. Specifically, findings suggest that Western media exposure may perpetuate, maintain, and/or intensify unrealistic standards of the male body as exposure to hyper-muscular and positively valenced media figures can enhance one's preferences for such body types. This could be increasing the pressure men feel to achieve similar physiques. Furthermore, this work suggests that women's preferences for male bodies are also warped by the images that make up their visual diets, and this could be placing additional pressures on men to achieve the body types that they feel women would prefer.

This thesis has shed light on the understudied research area of male body image, musculature preferences and manipulation of such preferences in men, women, boys and girls. It has emphasised the importance of further research in this area as a means to build upon the body of work described in this thesis. Indeed, this is a research area that is inadequately represented within the current literature. The hope is that the empirical work presented in this thesis will encourage other researchers to address this neglected field and gain a better understanding of this often misunderstood and under-represented area of work.

Appendices

Appendix A

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, condition as the between subjects factor, and the different subscale components of the SATAQ-4 score as a covariate (excluding the Pressures-Peers component which is presented in Table 3.4) for men. Critical tests are shown in bold.

Source	*df*	*F*	*p*	ηp^2
Phase	1,76	.268	.606	.004
Condition	1,76	1.620	.207	.021
Internalisation-Muscular	1,76	9.556	.003**	.112
Condition*Internalisation-Muscular	1,76	3.175	.079	.040
Phase*Condition	**1,76**	**.029**	**.866**	**.000**
Phase*Internalisation-Muscular	1,76	1.021	.315	.013
Phase*Condition*Internalisation-Muscular	**1,76**	**1.435**	**.235**	**.019**

Source	*df*	*F*	*p*	ηp^2
Phase	1,76	.059	.809	.001
Condition	1,76	1.839	.179	.024
Internalisation-Thin	1,76	1.357	.248	.018
Condition*Internalisation-Thin	1,76	.822	.368	.011
Phase*Condition	**1,76**	**.001**	**.973**	**.000**
Phase*Internalisation-Thin	1,76	.547	.462	.007
Phase*Condition*Internalisation-Thin	**1,76**	**1.117**	**.294**	**.014**

Source	*df*	*F*	*p*	ηp^2
Phase	1,76	.437	.510	.006
Condition	1,76	1.069	.304	.014
Pressures-Family	1,76	3.916	.051	.049
Condition*Pressures-Family	1,76	.029	.865	.000
Phase*Condition	**1,76**	**1.082**	**.302**	**.014**
Phase*Pressures-Family	1,76	2.378	.127	.030
Phase*Condition*Pressures-Family	**1,76**	**.518**	**.474**	**.007**

Source	*df*	*F*	*p*	ηp^2
Phase	1,76	.022	.884	.000
Condition	1,76	.588	.457	.007
Pressures-Media	1,76	.228	.634	.003
Condition*Pressures-Media	1,76	2.487	.119	.032
Phase*Condition	**1,76**	**.065**	**.799**	**.001**
Phase*Pressures-Media	1,76	.328	.568	.004
Phase*Condition*Pressures-Media	**1,76**	**3.224**	**.077**	**.041**

$^*p<.05$, $^{**}p<.01$

Appendix B.1

Correlations between age, and the five SATAQ-4 subscale scores (Internalisation-Muscular, Internalisation-Thin, Pressures- Family, Pressures-Peers, Pressures-Media), Total SATZAQ-4 scores, DMS scores and baseline preference for muscularity scores for all data, and data split by gender.

Int-Musc data overall	1	2	3	4
1. Age				
2. SATAQ-4 score	.450**			
3. Int-Musc SATAQ	.366**	.691**		
4. DMS score	.378**	.295**	.611**	
5. Preference for muscularity	.354**	.402**	.586**	.549**
Int-Musc male data only	1	2	3	4
1. Age				
2. SATAQ-4 score	.492**			
3. Int-Musc SATAQ	.466**	.837**		
4. DMS score	.616**	.701**	.778**	
5. Preference for muscularity	.400**	.450**	.636**	.752**
Int-Musc female data only	1	2	3	4
1. Age				
2. SATAQ-4 score	.440**			
3. Int-Musc SATAQ	.267**	.705**		
4. DMS score	.172	.190	.403**	
5. Preference for muscularity	.323**	.499**	.502**	.280**
Int-Thin data overall	1	2	3	4
1. Age				
2. SATAQ-4 score	.450**			
3. Int-Thin SATAQ	.289**	.843**		
4. DMS score	.378**	.295**	.058	
5. Preference for muscularity	.354**	.402**	.225**	.550**
Int-Thin male data only	1	2	3	4
1. Age				
2. SATAQ-4 score	.492**			
3. Int-Thin SATAQ	.226*	.791**		
4. DMS score	.616**	.701**	.497**	
5. Preference for muscularity	.400**	.450**	.312**	.752**
Int-Thin female data only	1	2	3	4
1. Age				
2. SATAQ-4 score	.440**			
3. Int-Thin	.376**	.862**		
4. DMS score	.172	.190	.027	
5. Preference for muscularity	.323**	.499**	.345**	.280**
Press-Fam data overall	1	2	3	4

	1	2	3	4
1. Age				
2. SATAQ-4 score	.450**			
3. Press-Fam SATAQ	.149*	.547**		
4. DMS score	.378**	.295**	.036	
5. Preference for muscularity	.354**	.402**	.178*	.550**
Press-Fam male data	1	2	3	4
1. Age				
2. SATAQ-4 score	.492**			
3. Pres-Fam SATAQ	.093	.388**		
4. DMS score	.616**	.701**	.134	
5. Preference for muscularity	.400**	.450**	.096	.752**
Press-Fam female data	1	2	3	4
1. Age				
2. SATAQ-4 score	.440**			
3. Press-Fam SATAQ	.191*	.637**		
4. DMS score	.172	.190	.076	
5. Preference for muscularity	.323**	.499**	.304**	.280**
Press-Peers data overall	1	2	3	4
1. Age				
2. SATAQ-4 score	.450**			
3. Press-Peers SATAQ	.272**	.786**		
4. DMS score	.378**	.295**	.197**	
5. Preference for muscularity	.354**	.402**	.241**	.550**
Press-Peers male data	1	2	3	4
1. Age				
2. SATAQ-4 score	.492**			
3. Press-Peers SATAQ	.353**	.799**		
4. DMS score	.616**	.701**	.496**	
5. Preference for muscularity	.400**	.450**	.226*	.752**
Press-Peers female data	1	2	3	4
1. Age				
2. SATAQ-4 score	.440**			
3. Press-Peers SATAQ	.205*	.771**		
4. DMS score	.172	.190	.047	
5. Preference for muscularity	.323**	.499**	.321**	.280**
Press-Media data overall	1	2	3	4
1. Age				
2. SATAQ-4 score	.450**			
3. Press-Media SATAQ	.533**	.853**		

	1	2	3	4
4. DMS score	.378**	.295**	.164*	
5. Preference for muscularity	.354**	.402**	.259	.550**
Press-Media male data	1	2	3	4
1. Age				
2. SATAQ-4 score	.492**			
3. Press-Media SATAQ	.566**	.805**		
4. DMS score	.616**	.701**	.561**	
5. Preference for muscularity	.400**	.450**	.292**	.752**
Press-Media female data	1	2	3	4
1. Age				
2. SATAQ-4 score	.440**			
3. Press-Media SATAQ	.591**	.839**		
4. DMS score	.172	.190	.177	
5. Preference for muscularity	.323**	.499**	.441**	.280**

Note: Five participants did not complete the SATAQ-4 items in full and ten participants did not complete the DMS items in full; these participants' data were excluded for the relevant score. The SATAQ-4 Internalisation-Muscular subscale is abbreviated to 'Int-Musc', Internalisation-Thin to 'Int-Thin', Pressures-Family to 'Press-Fam', Pressures-Peers to 'Press-Peers', and Pressures-Media to 'Press-Media'.

$^{*}p < .05$. $^{**}p < .01$.

Appendix B.2

Regression table for age, gender and all other SATAQ-4 subscale scores.

	Int-Thin	Press-Peers	Press-Fam	Press Media
Age	0.578** (0.128)	0.537** (0.135)	0.220* (0.107)	1.283** (0.130)
Gender	3.601** (0.569)	1.332** (0.600)	0.861 (0.474)	4.376** (0.577)
Age:Gender	0.369 (0.256)	-0.233 (0.270)	0.193 (0.213)	0.167 (0.259)
Constant	14.796** (0.285)	9.297** (0.300)	7.470** (0.237)	11.368** (0.288)
Observations	199	199	199	199
R2	0.255	0.099	0.044	0.452
Adjusted R2	0.243	0.085	0.029	0.443
Residual Std. Error	3.995	4.209	3.330	4.047
F Statistic	22.207**	7.131**	2.991*	53.575**

Note: Five participants did not complete the SATAQ-4 items in full and ten participants did not complete the DMS items in full; these participants' data were excluded for the relevant score. The SATAQ-4 Internalisation-Thin subscale is abbreviated to 'Int-Thin', Pressures-Family to 'Press-Fam', Pressures-Peers to 'Press-Peers', and Pressures-Media to 'Press-Media'.

$^*p<.05$, $^{**}p<.01$.

Appendix C

Original SATAQ-4 items (left) versus the revised SATAQ-4 items (right) created specifically for younger participants; <=14 years-old.

Original SATAQ-4 items	Revised SATAQ-4 items for <=14 years-old
Please read each of the following items carefully and indicate the number that best reflects your agreement with the statement.	Please read each of the following questions carefully. For each one, choose the number that shows how much you agree or disagree with that statement.
Definitely Disagree = 1 Mostly Disagree = 2 Neither Agree Nor Disagree = 3 Mostly Agree = 4 Definitely Agree = 5	Definitely Disagree = 1 Mostly Disagree = 2 Neither Agree Nor Disagree = 3 Mostly Agree = 4 Definitely Agree = 5
1. It is important for me to look athletic.	1. It is important for my body to look strong and like I do a lot of sport.
2. I think a lot about looking muscular.	2. I think a lot about my body having muscles on it.
3. I want my body to look very thin.	3. I want my body to look very thin.
4. I want my body to look like it has little fat.	4. I want my body to look like it does not have much fat on it.
5. I think a lot about looking thin.	5. I think a lot about my body being thin.
6. I spend a lot of time doing things to look more athletic.	6. I spend a lot of time doing things to make my body look strong_
7. I think a lot about looking athletic	7. I think a lot about looking strong, like I do a lot of sport.
8. I want my body to look very lean.	8. I want my body to look very slim.
9. I think a lot about having very little body fat.	9. I think a lot about wanting to have very little fat on my body.
10. I spend a lot of time doing things to look more muscular.	10. I spend a lot of time doing things so that my body looks stronger.
Answer the following questions with relevance to your FAMILY include parents, brothers, sisters, relatives :	When you answer these questions, please think about how your FAMILY parents, brothers, sisters and other relatives make you feel.
	The word **PRESSURE** means **to feel like someone wants you to be a certain way.**
11. I feel pressure from family members to look thinner.	11. I feel pressure from my family members to look thinner.
12. I feel pressure from family members to improve my appearance.	12. I feel pressure from family members to improve the way I look.
13. Family members encourage me to decrease my level of body fat.	

14. Family members encourage me to get in better shape.	13. Family members encourage me to have less fat on my body. 14. Family members encourage me to make my body look healthier.
Answer the following questions with relevance to your PEERS include close friends, classmates, and other social contacts : 15. My peers encourage me to get thinner. 16. I feel pressure from my peers to improve my appearance. 17. I feel pressure from my peers to look in better shape. 18. I get pressure from my peers to decrease my level of body fat.	When you answer these questions, please think about how your FRIENDS make you feel include close friends and classmates . Remember the word **PRESSURE** means **to feel like someone wants you to be a certain way** 15. My friends/classmates encourage me to get thinner. 16. I feel pressure from my friends/classmates to improve the way I look. 17. I feel pressure from my friends/classmates to make my body look healthier. 18. I get pressure from my friends/classmates to have less fat on my body.
Answer the following questions with relevance to the MEDIA include television, magazines, the internet, movies, billboards, and advertisements : 19. I feel pressure from the media to look in better shape. 20. I feel pressure from the media to look thinner. 21. I feel pressure from the media to improve my appearance. 22. I feel pressure from the media to decrease my level of body fat.	Answer the following questions about how the MEDIA makes you feel. **The media includes anything we might watch on television, read in magazines or see on the internet, social media and in adverts:** 19. I feel pressure from the media to make my body look healthier. 20. I feel pressure from the media to make my body look thinner. 21. I feel pressure from the media to improve how I look. 22. I feel pressure from the media to have less fat on my body.

Appendix D.1

The frequency at which each category theme was referred to amongst those in Sample 1 for high muscle mass media images and low muscle mass media images for all data, male data only and female data only. Highlighted cells represent categories that are most frequently referred to (ignoring the 'Other' category).

	Frequency for the High Muscle Mass Media Images (%)			Frequency for the Low Muscle Mass Media Images (%)		
Category	All Data	Male Data	Female Data	All Data	Male Data	Female Data
1. High Athleticism /Muscularity	39.7	42.1	37.6	3.0	4.6	1.6
2. Low Athleticism /Muscularity	0.3	0.6	0	11.8	13.5	10.4
3. High Confidence /Extraversion	11	12.2	9.8	2.7	3.1	2.5
4. Low Confidence /Introversion	0.6	0	1.1	10.1	8.3	11.7
5. Arrogance and Related Traits	13	12.2	13.6	1.9	0.9	2.7
6. Determination and Related Traits	6.4	5.1	7.6	1.4	1.2	1.6
7.High Approachability and Related Traits	4.7	2.7	6.5	13.6	8.9	17.7
8. High Physical Attractiveness	3.7	3.3	4.1	0.4	0	0.8
9. Aggressive/ Intimidating Nature	3.3	2.4	4.1	0.4	0.3	0.5
10. Happy	2.8	4.5	1.4	4.0	6.4	1.9
11. High Intelligence	0.3	0	0.5	11.8	10.1	13.4
12. Irritating, Undesirable Traits	4.6	4.8	4.4	7.4	6.1	8.4
13. Averageness	0	0	0	5.3	6.7	4.1
14. Not Popular or Cool	0.1	0.3	0	2.2	3.7	0.8
15. Low Intelligence	0.4	0.9	0	0.1	0.3	0
16. Popular and/or Cool	1.4	0.6	2.2	2.3	2.8	1.9
17. Unhappy	0.4	0.9	0	6.5	6.4	6.5
18. Youthful Appearance	0	0	0	1.0	0.3	1.6
19. Other	4.1	4.8	3.5	9.4	10.7	8.2
20. No Response Provided	3.1	2.7	3.5	4.5	5.5	3.5

Appendix D.2

The frequency at which each category theme was referred to amongst those in Sample 1 for high muscle mass media images and low muscle mass media images for all data, male data (boys) only and female data (girls) only, separated into the 11-14-year-old age category and the 15-18-year-old age category. Highlighted cells represent categories that are most frequently referred to (ignoring the 'Other' and 'No response provided' categories).

	Frequency for the High Muscle Mass Media Images (%)						Frequency for the Low Muscle Mass Media Images (%)					
Category	All 11-14 year olds	All 15-18 years olds	Boys 11-14 year olds	Boys 15-18 year olds	Girls 11-14 year olds	Girls 15–18-year olds	All 11-14 year olds	All 15-18 year olds	Boys 11-14 year olds	Boys 15-18 year olds	Girls 11-14 year olds	Girls 15-18 year olds
1. High Athleticism /Muscularity	55.5	26.1	57.8	27.1	55.4	25.5	4.0	2.2	4.9	2.5	3.5	2.5
2. Low Athleticism /Muscularity	0.6	0	0.7	0	0.3	0	16	8.2	18.3	8.5	16.6	7.5
3. High Confidence /Extraversion	5.5	15.7	4.4	14.6	4.5	16.4	2.1	3.3	1.5	3.5	1.7	3.1
4. Low Confidence /Introversion	0.3	0.8	0	0.6	0.3	0.9	6.4	13.4	4.1	12.9	6.9	13.4
5. Arrogance and Related Traits	8.0	17.3	7.4	15.5	7.3	16.7	2.1	1.6	2.2	1.6	2.4	1.6
6. Determination and Related Traits	3.7	8.8	3.7	8.8	4.2	8.8	2.1	0.8	2.6	0.6	2.1	0.9
7. High Approachability and Related Traits	4.3	5.1	3.7	4.9	4.9	5.5	13.2	13.9	10.8	13.2	12.5	15.0
8. High Physical Attractiveness	4.3	3.2	4.4	3.6	4.5	3.6	0.6	0.3	0	0.3	0.7	0.3
9. Aggressive/ Intimidating Nature	2.1	4.3	2.2	4.3	2.1	4.6	0	0.8	0	0.9	0	0.9
10. Happy	0.6	4.8	0.7	5.2	0.7	4.3	1.8	6.0	1.1	6.9	2.1	4.4

11. High Intelligence	0	0.5	0	0.3	0	0.6	10.4	13.1	10.8	11.7	10.7	13.7
12. Irritating, Undesirable Traits	3.4	5.6	3.7	6.1	3.1	5.5	4.3	10.1	5.2	8.8	3.8	10.0
13. Averageness	0	0	0	0	0	0	5.8	4.9	6.7	5.4	5.2	5.3
14. Not Popular or Cool	0.3	0	0.4	0	0.3	0	1.8	2.5	2.2	2.5	1.7	2.5
15. Low Intelligence	0	0.8	0	0.9	0	0.6	0.3	0	0.4	0	0	0
16. Popular and/or Cool	1.8	1.1	1.9	1.2	2.1	0.9	1.8	2.7	1.9	3.2	1.4	2.8
17. Unhappy	0	0.8	0	0.9	0	0.9	7.7	5.4	7.5	5.7	7.6	5.6
18. Youthful Appearance	0	0	0	0	0	0	1.2	0.8	1.5	0.9	1.4	0.9
19. Other	4.0	4.3	4.1	4.9	4.5	4.0	11.3	7.6	11.9	7.9	12.8	6.9
20. No Response Provided	5.5	1.1	4.8	1.2	5.6	1.2	6.7	2.5	6.3	2.8	6.9	2.8

Appendix D.3

The frequency at which each category theme was referred to amongst those in the Sample 1 for high muscle mass media images and low muscle mass media images for all data, male data (boys) only and female data (girls) only, separated into high and low internalisation of the muscular ideal groups as measured by SATAQ-4 Internalisation-Muscular (Int-Musc) subscale scores. Highlighted cells represent categories that are most frequently referred to (ignoring the 'Other' category).

	Frequency for the High Muscle Mass Media Images (%)						Frequency for the Low Muscle Mass Media Images (%)					
Category	All High Int-Musc	All Low Int-Musc	Boy High Int-Musc	Boy Low Int-Musc	Girl High Int-Musc	Girl Low Int-Musc	All High Int-Musc	All Low Int-Musc	Boy High Int-Musc	Boy Low Int-Musc	Girl High Int-Musc	Girl Low Int-Musc
1. High Athleticism /Muscularity	32.9	45.9	20.7	48.7	31.2	44.2	2.0	4.1	1.3	5.5	1.0	3.0
2. Low Athleticism /Muscularity	0.3	0.3	1.2	0.4	0.0	0.0	11.3	11.5	9.0	14.3	9.0	11.4
3. High Confidence /Extraversion	10.8	10.3	7.3	12.6	10.6	9.1	4.1	1.8	3.8	3.4	2.5	2.4
4. Low Confidence /Introversion	0.3	0.9	0.0	0.0	0.5	1.8	10.8	9.2	3.8	9.3	13.9	9.0
5. Arrogance and Related Traits	13.0	13.3	8.5	13.9	17.1	9.7	1.2	3.3	0.0	2.1	3.5	1.8
6. Determination and Related Traits	7.9	5.1	9.8	3.8	10.1	4.8	0.9	2.1	1.3	1.3	1.0	2.4
7. High Approachability and Related Traits	5.7	3.9	4.9	2.1	8.0	4.8	13.1	13.9	6.4	9.3	17.9	17.5
8. High Physical Attractiveness	3.7	3.9	8.5	1.7	2.5	6.1	0.9	0.6	0.0	0.0	1.5	1.2
9. Aggressive/ Intimidating Nature	4.2	2.4	6.1	1.3	5.0	3.0	0.3	0.9	0.0	0.8	1.0	0.0
10. Happy	4.8	0.6	8.5	2.9	2.5	0.0	7.0	1.2	14.1	4.2	3.0	0.6
11. High Intelligence	0.6	0.0	0.0	0.0	1.0	0.0	12.2	11.8	11.5	10.1	13.9	12.7

12. Irritating, Undesirable Traits	5.9	3.3	7.3	4.2	5.0	3.6	7.0	5.9	6.4	3.8	10.9	4.8
13. Averageness	0.0	0.0	0.0	0.0	0.0	0.0	7.0	4.7	15.4	5.5	3.0	5.4
14. Not Popular or Cool	0.0	0.3	0.0	0.4	0.0	0.0	3.2	1.8	5.1	4.2	1.0	0.6
15. Low Intelligence	0.8	0.0	2.4	0.4	0.0	0.0	0.3	0.3	0.0	0.4	0.5	0.0
16. Popular and/or Cool	1.4	1.5	1.2	0.4	1.5	3.0	2.6	2.1	5.1	2.1	2.0	1.8
17. Unhappy	0.8	0.0	1.2	0.8	0.0	0.0	4.1	8.6	3.8	7.2	3.5	9.6
18. Youthful Appearance	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.9	0.0	0.4	2.0	1.2
19. Other	4.2	4.2	11.0	2.9	3.0	4.2	6.4	10.9	7.7	10.1	7.5	8.4
20. No Response Provided	2.5	3.9	1.2	3.4	2.0	5.5	4.7	4.4	5.1	5.9	1.5	6.0

Note: Internalisation-Muscularity SATAQ-4 subscale scores were mean split to explore any differences in themes. The mean value of Internalisation-Muscularity SATAQ-4 scores was 15.37 (N=199). Those males and females who scored less than or the same as 15.37 (N=102) are represented in the 'All Data Low Int-Musc' group in the table above, and those who scored more than 15.37 (N=97) are represented by the 'All Data High Int-Musc' group. To investigate any potential gender differences, we mean-split Internalisation-Muscularity scores for males (M=15.98) and females (M=14.77).

Appendix D.4

The frequency at which each category was referred to amongst those in Sample 1 for high muscle mass media images and low muscle mass media images for all data, male data (boys) only and female data (girls) only, separated into high muscularity concerns (high DMS scores) and low muscularity concerns (Low DMS scores) groups. Highlighted cells represent categories that are most frequently referred to (ignoring the 'other' and 'No response provided' categories).

	Frequency for the High Muscle Mass Media Images (%)						Frequency for the Low Muscle Mass Media Images (%)					
Category	All High DMS	All Low DMS	Boy High DMS	Boy Low DMS	Girl High DMS	Girl Low DMS	All High DMS	All Low DMS	Boy High DMS	Boy Low DMS	Girl High DMS	Girl Low DMS
1. High Athleticism /Muscularity	33.1	45.4	27.7	56.5	29.8	45.1	2.1	3.9	3.1	6.1	1.7	1.7
2. Low Athleticism /Muscularity	0.6	0.0	1.2	0.0	0.0	0.0	11.6	12.7	12.5	15.0	7.5	13.8
3. High Confidence /Extraversion	13.3	9.1	15.1	9.5	12.4	8.0	3.3	1.8	4.4	1.4	2.3	2.2
4. Low Confidence /Introversion	0.0	1.2	0.0	0.0	0.6	1.7	11.2	8.4	9.4	5.4	12.7	11.0
5. Arrogance and Related Traits	15.4	11.3	13.9	10.9	18.5	9.7	1.5	2.1	0.6	0.7	2.9	2.8
6. Determination and Related Traits	7.7	5.2	7.8	2.7	9.0	5.7	1.5	1.2	0.6	1.4	1.7	1.7
7. High Approachability and Related Traits	3.8	4.9	3.6	0.7	6.2	6.3	12.2	14.8	10.6	6.8	19.7	15.5
8. High Physical Attractiveness	2.7	3.7	3.6	1.4	2.8	4.6	0.3	0.6	0.0	0.0	0.6	0.0
9. Aggressive/ Intimidating Nature	3.8	2.7	1.8	2.7	5.6	2.9	0.0	0.9	0.0	0.7	0.0	1.1
10. Happy	4.4	1.5	7.8	1.4	2.8	0.0	7.0	1.2	10.6	2.7	3.5	0.0
11. High Intelligence	0.6	0.0	0.0	0.0	1.1	0.0	10.3	13.9	8.8	12.2	13.9	13.3

12. Irritating, Undesirable Traits	5.0	4.3	5.4	4.3	5.6	2.9	8.8	5.4	7.5	4.8	11.0	5.0
13. Averageness	0.0	0.0	0.0	0.0	0.0	0.0	7.3	3.9	10.0	4.1	3.5	0.0
14. Not Popular or Cool	0.0	0.3	0.0	0.7	0.0	0.0	2.1	2.1	3.8	3.4	1.2	0.6
15. Low Intelligence	0.9	0.0	1.8	0.0	0.0	0.0	0.3	0.0	0.0	0.7	0.0	0.0
16. Popular and/or Cool	0.9	2.1	1.2	0.0	3.4	0.0	2.7	1.8	3.1	2.0	1.7	2.2
17. Unhappy	0.9	0.0	1.8	0.0	0.0	0.0	4.0	8.4	4.4	7.5	6.4	6.6
18. Youthful Appearance	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.3	0.0	0.7	2.9	0.6
19. Other	5.6	2.7	6.6	3.4	3.4	3.4	9.1	10.2	8.8	14.3	6.9	9.4
20. No Response Provided	1.2	5.5	0.6	5.5	0.6	6.9	2.7	6.3	1.9	10.2	0.0	6.6

Note: DMS scores were mean split to explore any differences in themes. The mean value of Internalisation-Muscularity SATAQ-4 scores was 29 (N=204). Those males and females who scored less than or the same as 29 (N=98) are represented in the 'All Data Low DMS' group in the table above, and those who scored more than 29 (N=96) are represented by the 'All Data High DMS' group. To investigate any potential gender differences, we mean-split DMS scores for males (M=36.5) and females (M=24).

Appendix D.5

The frequency at which each category theme was referred to amongst those in Sample 2 for high muscle mass media images and low muscle mass media images for all data, male data only and female data only. Highlighted cells represent categories that are most frequently referred to (ignoring the 'Other' and 'No response Provided' category).

	Frequency for the High Muscle Mass Media Images (%)			Frequency for the Low Muscle Mass Media Images (%)		
Category	All Data	Male Data	Female Data	All Data	Male Data	Female Data
1. High Athleticism /Muscularity	41.3	39.5	43.3	3.5	3.1	4.0
2. Low Athleticism /Muscularity	0.3	0.6	0.0	4.2	4.9	3.3
3. High Confidence /Extraversion	0.9	1.2	0.7	0.6	0.6	0.7
4. Low Confidence /Introversion	0.3	0.6	0.0	2.2	1.8	2.7
5. Arrogance and Related Traits	2.5	2.4	2.7	1.6	3.1	0.0
6. Determination and Related Traits	3.2	2.4	4.0	0.0	0.0	0.0
7. High Approachability and Related Traits	4.4	5.4	3.3	8.9	9.2	8.7
8. High Physical Attractiveness	0.3	0.6	0.0	0.0	0.0	0.0
9. Aggressive/ Intimidating Nature	4.7	3.0	6.7	1.3	1.8	0.7
10. Happy	1.6	1.8	1.3	1.6	1.8	1.3
11. High Intelligence	0.0	0.0	0.0	7.7	7.4	8.0
12. Irritating, Undesirable Traits	5.7	6.6	4.7	6.7	6.7	6.7
13. Averageness	0.0	0.0	0.0	5.8	6.1	5.3
14. Not Popular or Cool	0.0	0.0	0.0	1.3	1.2	1.3
15. Low Intelligence	0.3	0.0	0.7	0.6	0.6	0.7
16. Popular and/or Cool	0.9	1.2	0.7	1.6	1.2	2.0
17. Unhappy	0.6	0.0	1.3	5.1	4.3	6.0
18. Youthful Appearance	0.0	0.0	0.0	3.5	3.7	3.3
19. Other	8.8	12.0	5.3	13.7	12.3	15.3
20. No Response Provided	24.0	22.8	25.3	30.0	30.1	30.0

Appendix D.6

The frequency at which each category was referred to amongst those 8-14-year-old boys in Sample 3 for high muscle mass media images and low muscle mass media images. Highlighted cells represent categories that are most frequently referred to (ignoring the 'other' category).

Category	Frequency for the High Muscle Mass Media Images (%)			Frequency for the Low Muscle Mass Media Images (%)		
	All Data	High Int-Musc	Low Int-Musc	All Data	High Int-Musc	Low Int-Musc
1. High Athleticism /Muscularity	56.3	55.3	57.5	2.8	2.7	2.9
2. Low Athleticism /Muscularity	0.3	0.6	0.0	22.2	24.3	19.9
3. High Confidence /Extraversion	4.1	6.3	1.5	2.1	2.0	2.2
4. Low Confidence /Introversion	0.7	0.0	1.5	4.2	3.4	5.1
5. Arrogance and Related Traits	2.7	1.9	3.7	0.4	0.7	0.0
6. Determination and Related Traits	5.8	6.9	4.5	1.1	1.4	0.7
7. High Approachability and Related Traits	7.5	6.9	8.2	9.9	8.8	11.0
8. High Physical Attractiveness	0.3	0.6	0.0	0.0	0.0	0.0
9. Aggressive/ Intimidating Nature	2.7	3.8	1.5	0.7	0.0	1.5
10. Happy	2.0	3.8	0.0	1.8	2.0	1.5
11. High Intelligence	1.0	0.6	1.5	17.3	18.9	15.4
12. Irritating, Undesirable Traits	3.1	3.1	3.0	4.2	2.7	5.9
13. Averageness	1.0	1.9	0.0	4.2	4.1	4.4

14. Not Popular or Cool	0.0	0.0	0.0	1.1	0.7	1.5
15. Low Intelligence	0.0	0.0	0.0	0.0	0.0	0.0
16. Popular and/or Cool	3.4	2.5	4.5	1.8	1.4	2.2
17. Unhappy	0.3	0.0	0.7	7.0	8.1	5.9
18. Youthful Appearance	0.0	0.0	0.0	1.1	0.0	2.2
19. Other	6.5	3.8	9.7	15.1	16.2	14.0
20. No Response Provided	2.0	1.9	2.2	3.2	2.7	3.7

Note: Internalisation-Muscularity SATAQ-4 subscale scores were mean split to explore any differences in themes. The mean value of Internalisation-Muscularity SATAQ-4 scores was 16.37 (N=85). Those who scored less than or the same as 16.37 (N=37) are represented in the 'All Data Low Int-Musc' group in the table above, and those who scored more than 16.37 (N=46) are represented by the 'All Data High Int-Musc' group.

Appendix E

Tabulated values for mixed ANOVA with phase (pre- versus post-manipulation preference for muscularity scores) as the repeated measures variable, and attentional bias towards muscularity score and the SATAQ-4 and DMS measures, total and subscale measures added as covariates for men (Models 1-9) and for women (Model 10-18).

Model 1 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.071	.791	.001
Attentional Bias Score	1,52	.515	.476	.010
Total SATAQ-4	1,52	.144	.706	.003
Phase*Attentional Bias Score	1,52	2.869	.096	.052
Phase*Total SATAQ-4	1,52	.030	.864	.001
Attentional Bias Score*Total SATAQ-4	1,52	.396	.532	.008
Phase* Attentional Bias Score*Total SATAQ-4	1,52	3.211	.079	.058
Model 2 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	2.517	.119	.046
Attentional Bias Score	1,52	.198	.658	.004
Internalisation-Muscularity SATAQ-4	1,52	6.652	.013	.113
Phase*Attentional Bias Score	1,52	6.104	.017	.105
Phase*Internalisation-Muscularity SATAQ-4	1,52	2.394	.128	.044
Attentional Bias Score*Internalisation-Muscularity SATAQ-4	1,52	.316	.577	.006
Phase* Attentional Bias Score*Internalisation-Muscularity SATAQ-4	1,52	7.398	.009**	.125
Model 3 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.919	.342	.017
Attentional Bias Score	1,52	.381	.540	.007
Internalisation-Thin SATAQ-4	1,52	2.985	.090	.054
Phase*Attentional Bias Score	1,52	.687	.411	.013
Phase*Internalisation-Thin	1,52	.579	.450	.011
Attentional Bias Score*Internalisation-Thin SATAQ-4	1,52	.253	.617	.005
Phase* Attentional Bias Score*Internalisation-Thin SATAQ-4	1,52	1.074	.305	.020
Model 4 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.139	.711	.003
Attentional Bias Score	1,52	.003	.956	.000
Pressures-Family SATAQ-4	1,52	.268	.607	.005
Phase*Attentional Bias Score	1,52	.047	.829	.001
Phase*Pressures-Family SATAQ-4	1,52	.648	.425	.012
Attentional Bias Score*Pressures-Family SATAQ-4	1,52	.000	.995	.000
Phase* Attentional Bias Score*Pressures-Family SATAQ-4	1,52	.179	.674	.003
Model 5 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.459	.501	.009

Attentional Bias Score	1,52	.455	.503	.009
Pressures-Peers SATAQ-4	1,52	.005	.942	.000
Phase*Attentional Bias Score	1,52	.517	.475	.010
Phase*Pressures-Peers SATAQ-4	1,52	1.186	.281	.022
Attentional Bias Score*Pressures-Peers SATAQ-4	1,52	.339	.563	.006
Phase* Attentional Bias Score* Pressures-Peers SATAQ-4	1,52	.414	.523	.008
Model 6 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.029	.866	.001
Attentional Bias Score	1,52	.224	.638	.004
Pressures-Media SATAQ-4	1,52	1.719	.196	.032
Phase*Attentional Bias Score	1,52	.498	.483	.009
Phase*Pressures-Media SATAQ-4	1,52	.267	.607	.005
Attentional Bias Score*Pressures-Media SATAQ-4	1,52	.098	.755	.002
Phase* Attentional Bias Score*Pressures-Media SATAQ-4	1,52	.711	.403	.013
Model 7 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.344	.560	.007
Attentional Bias Score	1,52	.880	.353	.017
Total DMS	1,52	.715	.402	.014
Phase*Attentional Bias Score	1,52	.003	.958	.000
Phase* Total DMS	1,52	.819	.370	.016
Attentional Bias Score* Total DMS	1,52	.901	.347	.017
Phase* Attentional Bias Score* Total DMS	1,52	.007	.935	.000
Model 8 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.195	.661	.004
Attentional Bias Score	1,52	.561	.457	.011
Attitudinal DMS	1,52	.538	.466	.010
Phase*Attentional Bias Score	1,52	.195	.661	.004
Phase* Attitudinal DMS	1,52	.609	.439	.012
Attentional Bias Score* Attitudinal DMS	1,52	.506	.480	.010
Phase* Attentional Bias Score* Attitudinal DMS	1,52	.095	.760	.002
Model 9 (Men)	*df*	*F*	*p*	ηp2
Phase	1,52	.009	.923	.000
Attentional Bias Score	1,52	.459	.501	.009
Behavioural DMS	1,52	2.788	.101	.051
Phase*Attentional Bias Score	1,52	.059	.809	.001
Phase* Behavioural DMS	1,52	.333	.566	.006
Attentional Bias Score* Behavioural DMS	1,52	.459	.501	.009
Phase* Attentional Bias Score* Behavioural DMS	1,52	.003	.960	.000
Model 10 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	.401	.528	.003
Attentional Bias Score	1,125	.195	.659	.002
Total SATAQ-4	1,125	7.750	.006	.058

Phase*Attentional Bias Score	1,125	.101	.752	.001
Phase*Total SATAQ-4	1,125	.004	.950	.000
Attentional Bias Score*Total SATAQ-4	1,125	.232	.631	.002
Phase* Attentional Bias Score*Total SATAQ-4	1,125	.001	.979	.000
Model 11 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	.814	.369	.006
Attentional Bias Score	1,125	1.106	.295	.009
Internalisation-Muscularity SATAQ-4	1,125	3.392	.068	.026
Phase*Attentional Bias Score	1,125	.680	.411	.005
Phase*Internalisation-Muscularity SATAQ-4	1,125	4.843	.030*	.037
Attentional Bias Score*Internalisation-Muscularity SATAQ-4	1,125	1.017	.315	.008
Phase* Attentional Bias Score*Internalisation-Muscularity SATAQ-4	1,125	.000	.992	.000
Model 12 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	.919	.342	.017
Attentional Bias Score	1,125	.381	.540	.007
Internalisation-Thin SATAQ-4	1,125	2.985	.090	.054
Phase*Attentional Bias Score	1,125	.687	.411	.013
Phase*Internalisation-Thin	1,125	.579	.450	.011
Attentional Bias Score*Internalisation-Thin SATAQ-4	1,125	.253	.617	.005
Phase* Attentional Bias Score*Internalisation-Thin SATAQ-4	1,125	1.074	.305	.020
Model 13 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	3.947	.049*	.031
Attentional Bias Score	1,125	1.880	.173	.015
Pressures-Family SATAQ-4	1,125	.942	.334	.007
Phase*Attentional Bias Score	1,125	.577	.449	.005
Phase*Pressures-Family SATAQ-4	1,125	.594	.442	.005
Attentional Bias Score*Pressures-Family SATAQ-4	1,125	1.957	.164	.015
Phase* Attentional Bias Score*Pressures-Family SATAQ-4	1,125	.104	.748	.001
Model 14 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	8.428	.004**	.063
Attentional Bias Score	1,125	.108	.743	.001
Pressures-Peers SATAQ-4	1,125	7.335	.008	.055
Phase*Attentional Bias Score	1,125	1.397	.239	.011
Phase*Pressures-Peers SATAQ-4	1,125	2.796	.097	.022
Attentional Bias Score*Pressures-Peers SATAQ-4	1,125	.000	1.000	.000
Phase* Attentional Bias Score* Pressures-Peers SATAQ-4	1,125	.002	.960	.000
Model 15 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	1.461	.229	.012
Attentional Bias Score	1,125	.174	.677	.001
Pressures-Media SATAQ-4	1,125	.853	.358	.007

Phase*Attentional Bias Score	1,125	.022	.883	.000
Phase*Pressures-Media SATAQ-4	1,125	.347	.557	.003
Attentional Bias Score*Pressures-Media SATAQ-4	1,125	.193	.661	.002
Phase* Attentional Bias Score*Pressures-Media SATAQ-4	1,125	.028	.868	.000
Model 16 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	.467	.496	.004
Attentional Bias Score	1,125	.247	.620	.002
Total DMS	1,125	3.548	.062	.028
Phase*Attentional Bias Score	1,125	1.828	.179	.014
Phase* Total DMS	1,125	.348	.556	.003
Attentional Bias Score* Total DMS	1,125	.201	.654	.002
Phase* Attentional Bias Score* Total DMS	1,125	.263	.609	.002
Model 17 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	1.563	.214	.012
Attentional Bias Score	1,125	.968	.327	.008
Attitudinal DMS	1,125	1.585	.210	.013
Phase*Attentional Bias Score	1,125	1.517	.220	.012
Phase* Attitudinal DMS	1,125	.003	.956	.000
Attentional Bias Score* Attitudinal DMS	1,125	1.058	.306	.008
Phase* Attentional Bias Score* Attitudinal DMS	1,125	.096	.757	.001
Model 18 (Women)	*df*	*F*	*p*	ηp2
Phase	1,125	.315	.576	.003
Attentional Bias Score	1,125	.466	.496	.004
Behavioural DMS	1,125	4.842	.030*	.037
Phase*Attentional Bias Score	1,125	2.342	.128	.018
Phase* Behavioural DMS	1,125	.875	.351	.007
Attentional Bias Score* Behavioural DMS	1,125	.632	.428	.005
Phase* Attentional Bias Score* Behavioural DMS	1,125	.396	.530	.003

*$p<.05$, **$p<.01$

References

Adams, G., Turner, H., & Bucks, R. (2005). The experience of body dissatisfaction in men. *Body image*, *2*(3), 271-283.

Agliata, D., & Tantleff-Dunn, S. (2004). The impact of media exposure on males' body image. *Journal of social and clinical psychology*, *23*(1), 7-22.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author. Online version.

Anderson, J. L., Crawford, C. B., Nadeau, J., & Lindberg, T. (1992). Was the Duchess of Windsor right? A cross-cultural review of the socioecology of ideals of female body shape. *Ethology and Sociobiology*, *13*(3), 197-227.

Anschutz, D. J., Engels, R. C., & Van Strien, T. (2012). Increased body satisfaction after exposure to thin ideal children's television in young girls showing thin ideal internalisation. *Psychology & Health*, *27*(5), 603-617.

Anzures, G., Mondloch, C. J., & Lackner, C. (2009). Face adaptation and attractiveness aftereffects in 8-year-olds and adults. *Child Development*, *80*(1), 178-191.

Apicella, C. L., Feinberg, D. R., & Marlowe, F. W. (2007). Voice pitch predicts reproductive success in male hunter-gatherers. *Biology letters*, *3*(6), 682-684.

Arbour, K. P., & Ginis, K. A. M. (2006). Effects of exposure to muscular and hypermuscular media images on young men's muscularity dissatisfaction and body dissatisfaction. *Body image*, *3*(2), 153-161.

Aubrey, J. S. (2006). Effects of sexually objectifying media on self-objectification and body surveillance in undergraduates: Results of a 2-year panel study. *Journal of communication*, *56*(2), 366-386.

Baghurst, T., Hollander, D. B., Nardella, B., & Haff, G. G. (2006). Change in sociocultural ideal male physique: An examination of past and present action figures. *Body Image*, *3*(1), 87-91.

Barlett, C., Harris, R., Smith, S., & Bonds-Raacke, J. (2005). Action figures and men. *Sex Roles*, *53*, 877-885.

Barlett, C. P., Vowels, C. L., & Saucier, D. A. (2008). Meta-analyses of the effects of media images on men's body-image concerns. *Journal of social and clinical psychology*, *27*(3), 279-310.

Barra, J. V., Silva, W. R. D., Marôco, J., & Campos, J. A. D. B. (2019). Cross-cultural adaptation and validation of the Questionnaire of Sociocultural Attitudes towards Appearance-4 (SATAQ-4) applied to university students. *Cadernos de Saúde Pública*, *35*, e00170218.

Batish, A., Parchment, A., Tovee, M., & Boothroyd, L. (2019, January 9). Body size after-effects are adult-like from 11 years onwards. https://doi.org/10.31234/osf.io/7avs9

Bennett, E., & Gough, B. (2013). In pursuit of leanness: The management of appearance, affect and masculinities within a men’s weight loss forum. *Health:*, *17*(3), 284-299.

Bergeron, D., & Tylka, T. L. (2007). Support for the uniqueness of body dissatisfaction from drive for muscularity among men. *Body Image*, *4*(3), 288-295.

Berrisford-Thompson, J., Sayers, S., Bell, J., Dondzilo, L., & Kennedy, B. L. (2021). Blinded by bodies: Elevated eating disorder symptomatology is associated with increased attentional priority for thin bodies. *Body Image*, *39*, 237-247.

Blond, A. (2008). Impacts of exposure to images of ideal bodies on male body dissatisfaction: A review. *Body image*, *5*(3), 244-250.

Boothroyd, L. G., Jones, B. C., Burt, D. M., & Perrett, D. I. (2007). Partner characteristics associated with masculinity, health and maturity in male faces. *Personality and individual Differences*, *43*(5), 1161-1173.

Boothroyd, L. G., Jucker, J. L., Thornborrow, T., Jamieson, M. A., Burt, D. M., Barton, R. A., ... & Tovee, M. J. (2016). Television exposure predicts body size ideals in rural Nicaragua. *British Journal of Psychology*, *107*(4), 752-767.

Boothroyd, L. G., Tovée, M. J., & Evans, E. H. (2021). Can realistic dolls protect body satisfaction in young girls?. *Body Image*, *37*, 172-180.

Boothroyd, L. G., Tovée, M. J., & Pollet, T. V. (2012). Visual diet versus associative learning as mechanisms of change in body size preferences. *PLoS One*, *7*(11), e48691.

Bould, H., Carnegie, R., Allward, H., Bacon, E., Lambe, E., Sapseid, M., Button, K., Lewis, G., Skinner, A., Broome, M., Park, R., Harmer, C., Penton-Voak, I., & Munafò, M. R. (2018). Effects of exposure to bodies of different sizes on perception of and satisfaction with own body size: two randomized studies. *Royal Society Open Science*, *5*(5), 171387.

Bould, H., Noonan, K., Penton-Voak, I., Skinner, A., Munafò, M. R., Park, R. J., Broome, M., & Harmer, C. J. (2020). Does repeatedly viewing overweight versus underweight images change perception of and satisfaction with own body size?. *Royal Society Open Science*, *7*(4), 190704.

Boyd, H., & Murnen, S. K. (2017). Thin and sexy vs. muscular and dominant: Prevalence of gendered body ideals in popular dolls and action figures. *Body image*, *21*, 90-96.

Brooks, K. R., Clifford, C. W., Stevenson, R. J., Mond, J., & Stephen, I. D. (2018). The high-level basis of body adaptation. *Royal Society open science*, *5*(6), 172103.

Brooks, K. R., Mond, J., Mitchison, D., Stevenson, R. J., Challinor, K. L., & Stephen, I. D. (2020b). Looking at the figures: visual adaptation as a mechanism for body-size and-shape misperception. *Perspectives on Psychological Science*, *15*(1), 133-149.

Brooks, K. R., Mond, J. M., Stevenson, R. J., & Stephen, I. D. (2016). Body image distortion and exposure to extreme body types: contingent adaptation and cross adaptation for self and other. *Frontiers in neuroscience*, *10*, 334.

Brooks, K. R., Keen, E., Sturman, D., Mond, J., Stevenson, R. J., & Stephen, I. D. (2020a). Muscle and fat aftereffects and the role of gender: implications for body image disturbance. *British Journal of Psychology*, *111*(4), 742-761.

Brown, Z., & Tiggemann, M. (2016). Attractive celebrity and peer images on Instagram: Effect on women's mood and body image. *Body image*, *19*, 37-43.

Bucchianeri, M. M., Arikian, A. J., Hannan, P. J., Eisenberg, M. E., & Neumark-Sztainer, D. (2013). Body dissatisfaction from adolescence to young adulthood: Findings from a 10-year longitudinal study. *Body image*, *10*(1), 1-7.

Bucchianeri, M. M., Serrano, J. L., Pastula, A., & Corning, A. F. (2014). Drive for muscularity is heightened in body-dissatisfied men who socially compare. *Eating disorders*, *22*(3), 221-232.

Cafri, G., Strauss, J., & Thompson, J. K. (2002). Male body image: Satisfaction and its relationship to well-being using the somatomorphic matrix. *International Journal of Men's Health, 1*(2).

Cafri, G., & Thompson, J. K. (2004). Measuring male body image: a review of the current methodology. *Psychology of Men & Masculinity*, *5*(1), 18.

Cafri, G., Yamamiya, Y., Brannick, M., & Thompson, J. K. (2005). The influence of sociocultural factors on body image: a meta-analysis. *Clinical Psychology: science and practice*, *12*(4), 421.

Calzo, J. P., Sonneville, K. R., Haines, J., Blood, E. A., Field, A. E., & Austin, S. B. (2012). The development of associations among body mass index, body dissatisfaction, and weight and shape concern in adolescent boys and girls. *Journal of Adolescent Health*, *51*(5), 517-523.

Carbon, C. C., & Ditye, T. (2011). Sustained effects of adaptation on the perception of familiar faces. *Journal of Experimental Psychology: Human Perception and Performance*, *37*(3), 615.

Carbon, C. C., & Ditye, T. (2012). Face adaptation effects show strong and long-lasting transfer from lab to more ecological contexts. *Frontiers in psychology*, *3*, 3.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*(1), 111-126

Challinor, K. L., Mond, J., Stephen, I. D., Mitchison, D., Stevenson, R. J., Hay, P., & Brooks, K. R. (2017). Body size and shape misperception and visual adaptation: an overview of an emerging research paradigm. *Journal of International Medical Research*, *45*(6), 2001-2008.

Cheng, H. L., McDermott, R. C., Wong, Y. J., & La, S. (2016). Drive for muscularity in Asian American men: Sociocultural and racial/ethnic factors as correlates. *Psychology of Men & Masculinity*, *17*(3), 215.

Cho, A., & Lee, J. H. (2013). Body dissatisfaction levels and gender differences in attentional biases toward idealized bodies. *Body Image*, *10*(1), 95-102.

Christian, C., Perko, V. L., Vanzhula, I. A., Tregarthen, J. P., Forbush, K. T., & Levinson, C. A. (2020). Eating disorder core symptoms and symptom pathways across developmental stages: A network analysis. *Journal of abnormal psychology*, *129*(2), 177.

Clifford, C. W., & Rhodes, G. (2005). *Fitting the mind to the world: Adaptation and after-effects in high-level vision* (Vol. 2). Oxford University Press.

Cobb, N. J. (2010). *Adolescence: Continuity, change, and diversity* (7th ed.). Sinauer Associates.

Cramblitt, B., & Pritchard, M. (2013). Media's influence on the drive for muscularity in undergraduates. *Eating behaviors*, *14*(4), 441-446.

Dallesasse, S. L., & Kluck, A. S. (2013). Reality television and the muscular male ideal. *Body image*, *10*(3), 309-315.

Dally, P. (1977). Anorexia nervosa: Do we need a scapegoat. *Proceedings of the Royal Society of Medicine*, 70, 470– 474.

Damiano, S. R., Paxton, S. J., Wertheim, E. H., McLean, S. A., & Gregg, K. J. (2015). Dietary restraint of 5-year-old girls: Associations with internalization of the thin ideal and maternal, media, and peer influences. *International Journal of Eating Disorders*, *48*(8), 1166-1169.

Daniel, S., & Bridges, S. K. (2010). The drive for muscularity in men: Media influences and objectification theory. *Body image*, *7*(1), 32-38.

Davids, C. M., Watson, L. B., & Gere, M. P. (2019). Objectification, masculinity, and muscularity: A test of objectification theory with heterosexual men. *Sex Roles*, *80*, 443-457.

Davison, K. K., Markey, C. N., & Birch, L. L. (2000). Etiology of body dissatisfaction and weight concerns among 5-year-old girls. *Appetite*, *35*(2), 143-151.

De Ridder, C. M., De Boer, R. W., Seidell, J. C., Nieuwenhoff, C. M., Jeneson, J. A., Bakker, C. J., ... & Erich, W. B. (1992). Body fat distribution in pubertal girls quantified by magnetic resonance imaging. *International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity*, *16*(6), 443-449.

Diedrichs, P. C., Lee, C., & Kelly, M. (2011). Seeing the beauty in everyday people: A qualitative study of young Australians’ opinions on body image, the mass media and models. *Body Image*, *8*(3), 259-266.

Dijkstra, P., & Buunk, B. P. (2001). Sex differences in the jealousy-evoking nature of a rival's body build. *Evolution and Human Behavior*, *22*(5), 335-341.

Dittmar, H., Halliwell, E., & Ive, S. (2006). Does Barbie make girls want to be thin? The effect of experimental exposure to images of dolls on the body image of 5-to 8-year-old girls. *Developmental psychology*, *42*(2), 283.

Dittmar, H., Lloyd, B., Dugan, S., Halliwell, E., Jacobs, N., & Cramer, H. (2000). The "Body Beautiful": English adolescents' images of ideal bodies. *Sex Roles*, *42*(9-10), 887-915.

Dixson, B. J., Grimshaw, G. M., Ormsby, D. K., & Dixson, A. F. (2014). Eye-tracking women's preferences for men's somatotypes. *Evolution and Human Behavior*, *35*(2), 73-79.

Docherty, C., Lee, A. J., Hahn, A. C., DeBruine, L. M., & Jones, B. C. (2020). Do more attractive women show stronger preferences for male facial masculinity?. *Evolution and Human Behavior*, *41*(4), 312-317.

Dodge, T., Litt, D., Seitchik, A., & Bennett, S. (2008). Drive for muscularity and beliefs about legal performance enhancing substances as predictors of current use and willingness to use. *Journal of health psychology*, *13*(8), 1173-1179.

Dohnt, H. K., & Tiggemann, M. (2006a). Body image concerns in young girls: The role of peers and media prior to adolescence. *Journal of youth and adolescence*, *35*(2), 135-145.

Dohnt, H., & Tiggemann, M. (2006b). The contribution of peer and media influences to the development of body satisfaction and self-esteem in young girls: A prospective study. *Developmental psychology*, *42*(5), 929.

Dondzilo, L., Rieger, E., Palermo, R., Byrne, S., & Bell, J. (2017). The mediating role of rumination in the relation between attentional bias towards thin female bodies and eating disorder symptomatology. *PloS one*, *12*(5), e0177870.

Drummond, M. (2011). Reflections on the archetypal heterosexual male body. *Australian Feminist Studies*, *26*(67), 103-117.

Duggan, S. J., & McCreary, D. R. (2004). Body image, eating disorders, and the drive for muscularity in gay and heterosexual men: The influence of media images. *Journal of homosexuality*, *47*(3-4), 45-58.

Eysenck, M., MacLeod, C. & Mathews, A. (1987). "Cognitive functioning and anxiety". Psychological Research. 39: 189–195. doi:10.1007/bf00308686

Fallon, E. A., Harris, B. S., & Johnson, P. (2014). Prevalence of body dissatisfaction among a United States adult sample. *Eating behaviors, 15*(1), 151-158.

Fawkner, H. J. (2004). *Body image attitudes in men: An examination of the antecedents and consequent adjustive strategies and behaviors* (Doctoral dissertation, University of Melbourne, Department of Psychology, Faculty of Medicine, School of Behavioural Science).

Feinberg, D. R., Jones, B. C., Smith, M. L., Moore, F. R., DeBruine, L. M., Cornwell, R. E., ... & Perrett, D. I. (2006). Menstrual cycle, trait estrogen level, and masculinity preferences in the human voice. *Hormones and behavior*, *49*(2), 215-222.

Festinger, L. (1954). A theory of social comparison processes. *Human relations, 7*(2), 117-140.

Field, A. E., Austin, S. B., Camargo Jr, C. A., Taylor, C. B., Striegel-Moore, R. H., Loud, K. J., & Colditz, G. A. (2005). Exposure to the mass media, body shape concerns, and use of supplements to improve weight and shape among male and female adolescents. *Pediatrics*, *116*(2), e214-e220.

Fouts, G., & Burggraf, K. (1999). Television situation comedies: Female body images and verbal reinforcements. *Sex roles*, *40*(5), 473-481.

Fradkin, C., Wallander, J. L., Elliott, M. N., Tortolero, S., Cuccaro, P., & Schuster, M. A. (2015). Associations between socioeconomic status and obesity in diverse, young adolescents: variation across race/ethnicity and gender. *Health Psychology*, *34*(1), 1.

Frederick, D. A., Buchanan, G. M., Sadehgi-Azar, L., Peplau, L. A., Haselton, M. G., Berezovskaya, A., & Lipinski, R. E. (2007). Desiring the muscular ideal: Men's body satisfaction in the United States, Ukraine, and Ghana. *Psychology of Men & Masculinity*, *8*(2), 103.

Frederick, D. A., & Haselton, M. G. (2007). Why is muscularity sexy? Tests of the fitness indicator hypothesis. *Personality and Social Psychology Bulletin*, *33*(8), 1167-1183.

Galioto, R., & Crowther, J. H. (2013). The effects of exposure to slender and muscular images on male body dissatisfaction. *Body image*, *10*(4), 566-573.

Galmiche, M., Déchelotte, P., Lambert, G., & Tavolacci, M. P. (2019). Prevalence of eating disorders over the 2000–2018 period: a systematic literature review. *The American journal of clinical nutrition*, *109*(5), 1402-1413.

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and brain sciences*, *23*(4), 573-587.

Gangestad, S. W., Simpson, J. A., Cousins, A. J., Garver-Apgar, C. E., & Christensen, P. N. (2004). Women's preferences for male behavioral displays change across the menstrual cycle. *Psychological Science*, *15*(3), 203-207.

Garner, D. (1997). Body image survey results. *Psychology Today-New York-*, *30,* 30-45.

Giles, D. C., & Close, J. (2008). Exposure to 'lad magazines' and drive for muscularity in dating and non-dating young men. *Personality and Individual Differences*, *44*(7), 1610-1616.

Glauert, R., Rhodes, G., Byrne, S., Fink, B., & Grammer, K. (2009). Body dissatisfaction and the effects of perceptual exposure on body norms and ideals. *International Journal of Eating Disorders*, *42*(5), 443-452.

Glauert, R., Rhodes, G., Fink, B., & Grammer, K. (2010). Body dissatisfaction and attentional bias to thin bodies. *International Journal of Eating Disorders*, *43*(1), 42-49.

González, M. P. L., Paniagua, Á. I., Thornborrow, T., & Jordán, O. C. (2020). Associations Between Media Representations of Physical, Personality, and Social Attributes by Gender: A Content Analysis of Children's Animated Film Characters. *International Journal of Communication*, *14*, 23.

Greenleaf, C., Chambliss, H., Rhea, D. J., Martin, S. B., & Morrow Jr, J. R. (2006). Weight stereotypes and behavioral intentions toward thin and fat peers among White and Hispanic adolescents. *Journal of Adolescent Health*, *39*(4), 546-552.

Greenlee, M. W., Georgeson, M. A., Magnussen, S., & Harris, J. P. (1991). The time course of adaptation to spatial contrast. *Vision research*, *31*(2), 223-236.

Groesz, L. M., Levine, M. P., & Murnen, S. K. (2002). The effect of experimental presentation of thin media images on body satisfaction: A meta-analytic review. *International Journal of eating disorders*, *31*(1), 1-16.

Grogan, S. (2021). *Body image: Understanding body dissatisfaction in men, women, and children*. Routledge.

Grogan, S., & Richards, H. (2002). Body image: Focus groups with boys and men. *Men and masculinities*, *4*(3), 219-232.

Gruber, A. (2007). A more muscular female body ideal. In J. K. Thompson & G. Cafri (Eds.), *The muscular ideal: Psychological, social, and medical perspectives* (pp. 217–234). Washington, DC: American Psychological Association.

Halmi, K. A., Casper, R. C., Eckert, E. D., Goldberg, S. C., & Davis, J. M. (1979). Unique features associated with age of onset of anorexia nervosa. Psychiatry Research, 1(2), 209-215.

Hargreaves, D. A., & Tiggemann, M. (2006). 'Body Image is for Girls' A Qualitative Study of Boys' Body Image. *Journal of health psychology*, *11*(4), 567-576.

Hargreaves, D., & Tiggemann, M. (2003). The effect of "thin ideal" television commercials on body dissatisfaction and schema activation during early adolescence. *Journal of youth and adolescence*, *32*(5), 367-373.

Hargreaves, D. A., & Tiggemann, M. (2009). Muscular ideal media images and men's body image: Social comparison processing and individual vulnerability. *Psychology of Men & Masculinity, 10*(2), 109.

Harrison, K., & Hefner, V. (2006). Media exposure, current and future body ideals, and disordered eating among preadolescent girls: A longitudinal panel study. *Journal of Youth and Adolescence*, *35*(2), 146-156.

Hatoum, I. J., & Belle, D. (2004). Mags and abs: Media consumption and bodily concerns in men. *Sex Roles*, *51*(7), 397-407.

Hausenblas, H. A., Campbell, A., Menzel, J. E., Doughty, J., Levine, M., & Thompson, J. K. (2013). Media effects of experimental presentation of the ideal physique on eating disorder symptoms: A meta-analysis of laboratory studies. *Clinical psychology review*, *33*(1), 168-181.

Hawkins, N., Richards, P. S., Granley, H. M., & Stein, D. M. (2004). The impact of exposure to the thin-ideal media image on women. *Eating disorders*, *12*(1), 35-50.

Herbst, K. L., & Bhasin, S. (2004). Testosterone action on skeletal muscle. *Current Opinion in Clinical Nutrition & Metabolic Care*, *7*(3), 271-277.

Holland, J., Hall, N., Yeates, D. G., & Goldacre, M. (2016). Trends in hospital admission rates for anorexia nervosa in Oxford (1968–2011) and England (1990–2011): database studies. *Journal of the Royal Society of Medicine*, *109*(2), 59-66.

Holland, E., Wolf, E. B., Looser, C., & Cuddy, A. (2017). Visual attention to powerful postures: People avert their gaze from nonverbal dominance displays. *Journal of Experimental Social Psychology*, *68*, 60-67.

Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & Van de Weijer, J. (2011). *Eye tracking: A comprehensive guide to methods and measures*. OUP Oxford.

House, T., Graham, K., Ellis, B., Bould, H., Attwood, A. S., Stephen, I. D., ... & Penton-Voak, I. S. (2023). Is body dissatisfaction related to an attentional bias towards low weight bodies in non-clinical samples of women? A systematic review and meta-analysis. *Body Image*, *44*, 103-119.

House, T., Stephen, I. D., Penton-Voak, I. S., & Brooks, K. R. (2022). The effect of attention on body size adaptation and body dissatisfaction. *Royal Society Open Science*, *9*(2), 211718.

Hummel, D., Rudolf, A. K., Brandi, M. L., Untch, K. H., Grabhorn, R., Hampel, H., & Mohr, H. M. (2013). Neural adaptation to thin and fat bodies in the fusiform body area and middle occipital gyrus: an fMRI adaptation study. *Human brain mapping*, *34*(12), 3233-3246.

Hummel, D., Rudolf, A. K., Untch, K. H., Grabhorn, R., & Mohr, H. M. (2012). Visual adaptation to thin and fat bodies transfers across identity.

Jacques, K., Evans, E., & Boothroyd, L. (2021). Experimental manipulation of muscularity preferences through visual diet and associative learning. *Plos one*, *16*(8), e0255403.

Jankowski, G. S., Gough, B., Fawkner, H., Halliwell, E., & Diedrichs, P. C. (2018). Young men's minimisation of their body dissatisfaction. *Psychology & health*, *33*(11), 1343-1363.

Janssen, I., Heymsfield, S. B., Baumgartner, R. N., & Ross, R. (2000). Estimation of skeletal muscle mass by bioelectrical impedance analysis. *Journal of applied physiology*, *89*(2), 465-471.

Jin, X., Jin, Y., Zhou, S., Yang, S. N., Chang, S., & Li, H. (2018). Attentional biases toward body images in males at high risk of muscle dysmorphia. *PeerJ*, *6*, e4273.

Jones, D. C. (2001). Social comparison and body image: Attractiveness comparisons to models and peers among adolescent girls and boys. *Sex roles*, *45*(9), 645-664.

Jones, A. M., & Buckingham, J. T. (2005). Self–esteem as a moderator of the effect of social comparison on women's body image. *Journal of social and clinical psychology*, *24*(8), 1164-1187.

Joseph, C., LoBue, V., Rivera, L. M., Irving, J., Savoy, S., & Shiffrar, M. (2016). An attentional bias for thin bodies and its relation to body dissatisfaction. *Body image*, *19*, 216-223.

Jucker, J. L., Thornborrow, T., Beierholm, U., Burt, D. M., Barton, R. A., Evans, E. H., ... & Boothroyd, L. G. (2017). Nutritional status and the influence of TV consumption on female body size ideals in populations recently exposed to the media. *Scientific Reports*, *7*(1), 8438.

Jung, J., Forbes, G. B., & Chan, P. (2010). Global body and muscle satisfaction among college men in the United States and Hong Kong-China. *Sex roles*, *63*, 104-117.

Kirby, A. S., Jenks, R., Walsh, F., & Duncan, M. (2023). Attentional Biases Towards Body-Related Stimuli in Healthy Males: A Systematic Review. *Psychological Reports*, 00332941231177243.

Kleemans, M., Daalmans, S., Carbaat, I., & Anschütz, D. (2018). Picture perfect: The direct effect of manipulated Instagram photos on body image in adolescent girls. *Media Psychology*, *21*(1), 93-110.

Klimek, P., Murray, S. B., Brown, T., Gonzales IV, M., & Blashill, A. J. (2018). Thinness and muscularity internalization: Associations with disordered eating and muscle dysmorphia in men. *International Journal of Eating Disorders*, *51*(4), 352-357.

Klump, K. L. (2013). Puberty as a critical risk period for eating disorders: a review of human and animal studies. *Hormones and behavior*, *64*(2), 399-410.

Kouri, E. M., Pope Jr, H. G., Katz, D. L., & Oliva, P. (1995). Fat-free mass index in users and nonusers of anabolic-androgenic steroids. *Clinical Journal of Sport Medicine*, *5*(4), 223-228.

Kraig, K. A., & Keel, P. K. (2001). Weight-based stigmatization in children. *International Journal of Obesity*, *25*(11), 1661-1666.

Lassek, W. D., & Gaulin, S. J. (2009). Costs and benefits of fat-free muscle mass in men: Relationship to mating success, dietary requirements, and native immunity. *Evolution and Human Behavior*, *30*(5), 322-328.

Law, C., & Labre, M. P. (2002). Cultural standards of attractiveness: A thirty-year look at changes in male images in magazines. *Journalism & Mass Communication Quarterly*, *79*(3), 697-711.

Lee, C., & Owens, R. G. (2002). Issues for a psychology of men's health. *Journal of Health Psychology*, *7*(3), 209-217.

Legenbauer, T., Vocks, S., Schäfer, C., Schütt-Strömel, S., Hiller, W., Wagner, C., & Vögele, C. (2009). Preference for attractiveness and thinness in a partner: Influence of internalization of the thin ideal and shape/weight dissatisfaction in heterosexual women, heterosexual men, lesbians, and gay men. *Body Image*, *6*(3), 228-234.

Lei, X., Holzleitner, I. J., & Perrett, D. I. (2019). The influence of body composition effects on male facial masculinity and attractiveness. *Frontiers in Psychology*, *9*, 2658.

Leit, R. A., Gray, J. J., & Pope Jr, H. G. (2002). The media's representation of the ideal male body: A cause for muscle dysmorphia?. *International Journal of Eating Disorders*, *31*(3), 334-338.

Leit, R. A., Pope Jr, H. G., & Gray, J. J. (2001). Cultural expectations of muscularity in men: The evolution of Playgirl centerfolds. *International Journal of eating disorders*, *29*(1), 90-93.

Lennon, S. J., & Johnson, K. K. (2021). Men and muscularity research: A review. *Fashion and Textiles*, *8*(1), 1-21.

Lerner, R. M., & Korn, S. J. (1972). The development of body-build stereotypes in males. *Child Development*, 908-920.

Lewinsohn, P. M., Striegel-Moore, R. H., & Seeley, J. R. (2000). Epidemiology and natural course of eating disorders in young women from adolescence to young adulthood. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*(10), 1284-1292.

Lidborg, L. H., Cross, C. P., & Boothroyd, L. G. (2022). A meta-analysis of the association between male dimorphism and fitness outcomes in humans. *Elife*, *11*, e65031.

Litt, D., & Dodge, T. (2008). A longitudinal investigation of the Drive for Muscularity Scale: Predicting use of performance enhancing substances and weightlifting among males. *Body Image*, *5*(4), 346-351.

Little, A. C., DeBruine, L. M., & Jones, B. C. (2005). Sex-contingent face after-effects suggest distinct neural populations code male and female faces. *Proceedings of the Royal Society B: Biological Sciences*, *272*(1578), 2283-2287.

Little, A. C., DeBruine, L. M., Jones, B. C., & Waitt, C. (2008). Category contingent aftereffects for faces of different races, ages and species. *Cognition*, *106*(3), 1537-1547

Lorenzen, L. A., Grieve, F. G., & Thomas, A. (2004). Brief report: Exposure to muscular male models decreases men's body satisfaction. *Sex Roles*, *51*(11), 743-748.

Martins, N., Williams, D. C., Ratan, R. A., & Harrison, K. (2011). Virtual muscularity: A content analysis of male video game characters. *Body Image*, *8*(1), 43-51.

Mastro, D., & Figueroa-Caballero, A. (2018). Measuring extremes: A quantitative content analysis of prime time TV depictions of body type. *Journal of Broadcasting & Electronic Media*, *62*(2), 320-336.

Matthiessen, J., Velsing Groth, M., Fagt, S., Biltoft-Jensen, A., Stockmarr, A., Andersen, J. S., & Trolle, E. (2008). Prevalence and trends in overweight and obesity among children and adolescents in Denmark. *Scandinavian Journal of Public Health*, *36*(2), 153-160.

McCabe, M. P., Ricciardelli, L. A., & Banfield, S. (2001). Body image, strategies to change muscles and weight, and puberty: Do they impact on positive and negative affect among adolescent boys and girls?. *Eating behaviors*, *2*(2), 129-149.

McCabe, M. P., & Ricciardelli, L. A. (2003). Body image and strategies to lose weight and increase muscle among boys and girls. *Health psychology*, *22*(1), 39.

McCabe, M. P., & Ricciardelli, L. A. (2004). Body image dissatisfaction among males across the lifespan: A review of past literature. *Journal of psychosomatic research*, *56*(6), 675-685.

McLean, S. A., Rodgers, R. F., Slater, A., Jarman, H. K., Gordon, C. S., & Paxton, S. J. (2022). Clinically significant body dissatisfaction: Prevalence and association with depressive symptoms in adolescent boys and girls. *European child & adolescent psychiatry*, *31*(12), 1921-1932.

McCray, J. A. (2004). *The effects of exposure to images of the male muscular ideal on body image and muscularity concerns in men*. The University of North Dakota.

McCreary, D. R., Sasse, D. K., Saucier, D. M., & Dorsch, K. D. (2004). Measuring the drive for muscularity: factorial validity of the drive for muscularity scale in men and women. *Psychology of men & masculinity*, *5*(1), 49.

McCreary, D. R., & Sasse, D. K. (2000). An exploration of the drive for muscularity in adolescent boys and girls. *Journal of American college health*, *48*(6), 297-304.

McCreary, D. R. (2007). The Drive for Muscularity Scale: Description, Psychometrics, and Research Findings.

McLean, S. A., Wertheim, E. H., & Paxton, S. J. (2018). Preferences for being muscular and thin in 6-year-old boys. *Body image*, *26*, 98-102.

McPherson, K. E., McCarthy, P., McCreary, D. R., & McMillan, S. (2010). Psychometric evaluation of the Drive for Muscularity Scale in a community-based sample of Scottish men participating in an organized sporting event. *Body Image*, *7*(4), 368-371.

Mitchison, D., Mond, J., Griffiths, S., Hay, P., Nagata, J. M., Bussey, K., ... & Murray, S. B. (2022). Prevalence of muscle dysmorphia in adolescents: findings from the EveryBODY study. *Psychological Medicine*, *52*(14), 3142-3149.

Moriarty, C. M., & Harrison, K. (2008). Television exposure and disordered eating among children: A longitudinal panel study. *Journal of Communication*, *58*(2), 361-381.

Morrison, T. G., & Halton, M. (2009). Buff, tough, and rough: Representations of muscularity in action motion pictures. *The Journal of Men's Studies*, *17*(1), 57-74.

Morrison, D., Wang, H., Hahn, A. C., Jones, B. C., & DeBruine, L. M. (2017). Predicting the reward value of faces and bodies from social perception. *PloS one*, *12*(9), e0185093.

Morry, M. M., & Staska, S. L. (2001). Magazine exposure: Internalization, self-objectification, eating attitudes, and body satisfaction in male and female university students. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *33*(4), 269.

Mort, F. (1988) 'Boys' own? Masculinity, style and popular culture', in R. Chapman and J. Rutherford (Eds) Male order: Unwrapping masculinity, London: Lawrence and Wishart.

Moussally, J. M., Brosch, T., & Van der Linden, M. (2016). Time course of attentional biases toward body shapes: The impact of body dissatisfaction. *Body image*, *19*, 159-168.

Mulgrew, K. E., & Cragg, D. N. (2017). Age differences in body image responses to idealized male figures in music television. *Journal of Health Psychology*, *22*(6), 811-822.

Mulgrew, K. E., & Volcevski-Kostas, D. (2012). Short term exposure to attractive and muscular singers in music video clips negatively affects men's body image and mood. *Body image*, *9*(4), 543-546.

Nickson, D., Timming, A. R., Re, D., & Perrett, D. I. (2016). Subtle increases in BMI within a healthy weight range still reduce womens employment chances in the service sector. *PLoS One*, *11*(9), e0159659.

Norton, K. I., Olds, T. S., Olive, S., & Dank, S. (1996). Ken and Barbie at life size. *Sex roles*, *34*(3), 287-294.

Nouri, M., Hill, L. G., & Orrell-Valente, J. K. (2011). Media exposure, internalization of the thin ideal, and body dissatisfaction: Comparing Asian American and European American college females. *Body image*, *8*(4), 366-372.

Nowell, C., & Ricciardelli, L. A. (2008). Appearance-based comments, body dissatisfaction and drive for muscularity in males. *Body Image*, *5*(4), 337-345.

Nummenmaa, L., Hietanen, J. K., Santtila, P., & Hyönä, J. (2012). Gender and visibility of sexual cues influence eye movements while viewing faces and bodies. *Archives of sexual behavior*, *41*, 1439-1451.

Obeid, N., Norris, M. L., Buchholz, A., Henderson, K. A., Goldfield, G., Bedford, S., & Flament, M. F. (2018). Socioemotional predictors of body esteem in adolescent males. *Psychology of Men & Masculinity*, *19*(3), 439.

Paterna, Adrian, Manuel Alcaraz-Ibáñez, Matthew Fuller-Tyszkiewicz, and Álvaro Sicilia. "Internalization of body shape ideals and body dissatisfaction: A systematic review and meta-analysis." *International Journal of Eating Disorders* 54, no. 9 (2021): 1575-1600.

Peirce, J. W. (2007). PsychoPy—psychophysics software in Python. *Journal of neuroscience methods*, *162*(1-2), 8-13.

Pope Jr, H. G., Gruber, A. J., Choi, P., Olivardia, R., & Phillips, K. A. (1997). Muscle dysmorphia: An underrecognized form of body dysmorphic disorder. *Psychosomatics*, *38*(6), 548-557.

Pope Jr, H. G., Olivardia, R., Gruber, A., & Borowiecki, J. (1999). Evolving ideals of male body image as seen through action toys. *International journal of eating disorders*, *26*(1), 65-72.

Pope, H. G., Pope, H., Phillips, K. A., & Olivardia, R. (2000). *The Adonis complex: The secret crisis of male body obsession*. Simon and Schuster.

Quittkat, H. L., Hartmann, A. S., Düsing, R., Buhlmann, U., & Vocks, S. (2019). Body dissatisfaction, importance of appearance, and body appreciation in men and women over the lifespan. *Frontiers in psychiatry*, *10*, 864.

Reaves, S., Bush Hitchon, J., Park, S. Y., & Woong Yun, G. (2004). If looks could kill: Digital manipulation of fashion models. *Journal of Mass Media Ethics*, *19*(1), 56-71.

Rhodes, G., Jeffery, L., Clifford, C. W., & Leopold, D. A. (2007). The timecourse of higher-level face aftereffects. *Vision research*, *47*(17), 2291-2296.

Ricciardelli, L. A., & McCabe, M. P. (2001a). Self-esteem and negative affect as moderators of sociocultural influences on body dissatisfaction, strategies to decrease weight, and strategies to increase muscles among adolescent boys and girls. *Sex Roles*, *44*(3), 189-207.

Ricciardelli, L. A., & McCabe, M. P. (2001b). Children's body image concerns and eating disturbance: A review of the literature. *Clinical psychology review*, *21*(3), 325-344.

Ricciardelli, L. A., McCabe, M. P., & Ridge, D. (2006). The construction of the adolescent male body through sport. *Journal of health psychology*, *11*(4), 577-587.

Ricciardelli, L. A., McCabe, M. P., Mavoa, H., Fotu, K., Goundar, R., Schultz, J., ... & Swinburn, B. A. (2007). The pursuit of muscularity among adolescent boys in Fiji and Tonga. *Body Image*, *4*(4), 361-371.

Ricciardelli, L. A., McCabe, M. P., Williams, R. J., & Thompson, J. K. (2007). The role of ethnicity and culture in body image and disordered eating among males. *Clinical psychology review*, *27*(5), 582-606.

Ridley, B., Cornelissen, P., Maalin, N., Mohamed, S., Kramer, R. S., McCarty, K., & Tovée, M. J. (2022). The degree to which the cultural ideal is internalized predicts judgments of male and female physical attractiveness. *Frontiers in Psychology*, *13*, 980277.

Robinson, E., & Christiansen, P. (2014). The changing face of obesity: exposure to and acceptance of obesity. *Obesity*, *22*(5), 1380-1386.

Robinson, E., & Kirkham, T. C. (2014). Is he a healthy weight? Exposure to obesity changes perception of the weight status of others. *International Journal of Obesity*, *38*(5), 663-667.

Rousseau, A., Stevens Aubrey, J., & Eggermont, S. (2020). The impact of sports magazine consumption on mesomorphic body standards and self-sexualizing behaviors: A panel study of preadolescent boys. *Men and Masculinities*, *23*(2), 368-394.

Ryckman, R. M., Robbins, M. A., Kaczor, L. M., & Gold, J. A. (1989). Male and female raters' stereotyping of male and female physiques. *Personality and Social Psychology Bulletin*, *15*(2), 244-251.

Sadalla, E. K., Kenrick, D. T., & Vershure, B. (1987). Dominance and heterosexual attraction. *Journal of personality and social psychology*, *52*(4), 730.

Sawyer, S. M., Azzopardi, P. S., Wickremarathne, D., & Patton, G. C. (2018). The age of adolescence. *The Lancet Child & Adolescent Health*, *2*(3), 223-228.

Schaefer, L. M., Burke, N. L., Thompson, J. K., Dedrick, R. F., Heinberg, L. J., Calogero, R. M., ... & Swami, V. (2015). Development and validation of the sociocultural attitudes towards appearance questionnaire-4 (SATAQ-4). *Psychological assessment*, *27*(1), 54.

Schaefer, L. M., Burke, N. L., & Thompson, J. K. (2019). Thin-ideal internalization: How much is too much?. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *24*, 933-937.

Schooler, D., & Ward, L. M. (2006). Average Joes: Men's relationships with media, real bodies, and sexuality. *Psychology of Men & Masculinity, 7*(1), 27.

Sell, A., Cosmides, L., Tooby, J., Sznycer, D., Von Rueden, C., & Gurven, M. (2009). Human adaptations for the visual assessment of strength and fighting ability from the body and face. *Proceedings of the Royal Society B: Biological Sciences*, *276*(1656), 575-584.

Sell, A., Lukazsweski, A. W., & Townsley, M. (2017). Cues of upper body strength account for most of the variance in men's bodily attractiveness. *Proceedings of the Royal Society B: Biological Sciences*, *284*(1869), 20171819.

Slater, A., Halliwell, E., Jarman, H., & Gaskin, E. (2017). More than just child's play?: An experimental investigation of the impact of an appearance-focused internet game on body image and career aspirations of young girls. *Journal of youth and adolescence*, *46*(9), 2047-2059.

Smith, E., & Rieger, E. (2006). The effect of attentional bias toward shape-and weight-related information on body dissatisfaction. *International Journal of eating disorders*, *39*(6), 509-515.

Smithers, G., Gregory, J. R., Bates, C. J., Prentice, A., Jackson, L. V., & Wenlock, R. (2000). The National Diet and Nutrition Survey: young people aged 4–18 years. *Nutrition Bulletin*, *25*(2), 105-111.

Smolak, L., Levine, M. P., & Thompson, J. K. (2001). The use of the Sociocultural Attitudes Towards Appearance Questionnaire with middle school boys and girls. *International journal of eating disorders*, *29*(2), 216-223.

Staffieri, J. R. (1967). A study of social stereotype of body image in children. *Journal of personality and social psychology*, *7*(1p1), 101.

Stephen, I. D., Hunter, K., Sturman, D., Mond, J., Stevenson, R. J., & Brooks, K. R. (2019). Experimental manipulation of visual attention affects body size adaptation but not body dissatisfaction. *International Journal of Eating Disorders*, *52*(1), 79-87.

Stephen, I. D., Sturman, D., Stevenson, R. J., Mond, J., & Brooks, K. R. (2018). Visual attention mediates the relationship between body satisfaction and susceptibility to the body size adaptation effect. *PloS one*, *13*(1), e0189855.

Stice, E., Spangler, D., & Agras, W. S. (2001). Exposure to media-portrayed thin-ideal images adversely affects vulnerable girls: A longitudinal experiment. *Journal of social and clinical psychology*, *20*(3), 270-288.

Stratton, R., Donovan, C., Bramwell, S., & Loxton, N. J. (2015). Don't stop till you get enough: Factors driving men towards muscularity. *Body Image*, *15*, 72-80.

Sturman, D., Stephen, I. D., Mond, J., Stevenson, R. J., & Brooks, K. R. (2017). Independent Aftereffects of Fat and Muscle: Implications for neural encoding, body space representation, and body image disturbance. *Scientific reports*, *7*(1), 1-8.

Swami, V., Frederick, D. A., Aavik, T., Alcalay, L., Allik, J., Anderson, D., ... & Zivcic-Becirevic, I. (2010). The attractive female body weight and female body dissatisfaction in 26 countries across 10 world regions: Results of the International Body Project I. *Personality and social psychology bulletin*, *36*(3), 309-325.

Swami, V., Pietschnig, J., Stieger, S., Tovee, M. J., & Voracek, M. (2010). An investigation of weight bias against women and its associations with individual difference factors. *Body Image*, *7*(3), 194-199.

Swami, V., & Tovée, M. J. (2005a). Female physical attractiveness in Britain and Malaysia: A cross-cultural study. *Body image*, *2*(2), 115-128.

Swami, V., & Tovée, M. J. (2005b). Male physical attractiveness in Britain and Malaysia: A cross-cultural study. *Body image*, *2*(4), 383-393.

Swami, V., & Tovée, M. J. (2007). Differences in attractiveness preferences between observers in low-and high-resource environments in Thailand. *Journal of Evolutionary Psychology*, *5*(1), 149-160.

Swami, V., & Tovée, M. J. (2008). The muscular male: A comparison of the physical attractiveness preferences of gay and heterosexual men. *International Journal of Men's Health*, *7*(1), 59-71.

Sylvia, Z., King, T. K., & Morse, B. J. (2014). Virtual ideals: The effect of video game play on male body image. *Computers in Human Behavior*, *37*, 183-188.

Talbot, D., & Mahlberg, J. (2022). Beyond desirable: preferences for thinness and muscularity are greater than what is rated as desirable by heterosexual Australian undergraduate students. *Australian Psychologist*, *57*(2), 105-116.

Talbot, D., Smith, E., & Cass, J. (2019). Male body dissatisfaction, eating disorder symptoms, body composition, and attentional bias to body stimuli evaluated using visual search. *Journal of Experimental Psychopathology*, *10*(2), 2043808719848292.

Tatangelo, G. L., & Ricciardelli, L. A. (2017). Children's body image and social comparisons with peers and the media. *Journal of health psychology*, *22*(6), 776-787.

Thompson, J. K., Heinberg, L. J., Altabe, M., & Tantleff-Dunn, S. (1999a). Sociocultural theory: The media and society. In *Exacting beauty: Theory, assessment, and treatment of body image disturbance.* pp. 85–124. American Psychological Association.

Thompson, J. K., Heinberg, L. J., Altabe, M., & Tantleff-Dunn, S. (1999b). *Exacting beauty: Theory, assessment, and treatment of body image disturbance*. American Psychological Association.

Thompson, P., & Burr, D. (2009). Visual aftereffects. *Current Biology, 19*(1), R11-R14.

Thompson, A. M., & Chad, K. E. (2000). The relationship of pubertal status to body image, social physique anxiety, preoccupation with weight and nutritional status in young females. *Canadian journal of public health*, *91*(3), 207-211.

Thompson, M. L., & McKinney, E. C. (2020, December). Is the body positive movement too narrow?: extra large insights into plus size men and clothing offerings. In *International Textile and Apparel Association Annual Conference Proceedings* (Vol. 77, No. 1). Iowa State University Digital Press.

Thompson, J. K., Schaefer, L. M., Burke, N. L., Heinberg, L. J., Calogero, R. M., Bardone-Cone, A. M., & Vercellone, A. C. (2011, September). Development and validation of the 4th version of the Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ-4). In *Poster presented at the annual Eating Disorder Research Society Meeting, Edinburgh, Scotland*.

Thornborrow, T., Onwuegbusi, T., Mohamed, S., Boothroyd, L. G., & Tovée, M. J. (2020). Muscles and the media: A natural experiment across cultures in men's body image. *Frontiers in psychology*, 495.

Thornhill, R., Chapman, J. F., & Gangestad, S. W. (2013). Women's preferences for men's scents associated with testosterone and cortisol levels: Patterns across the ovulatory cycle. *Evolution and Human Behavior, 34*(3), 216-221.

Tiggemann, M. (2005). Body dissatisfaction and adolescent self-esteem: Prospective findings. *Body image*, *2*(2), 129-135.

Tiggemann, M., Martins, Y., & Kirkbride, A. (2007). Oh to be lean and muscular: body image ideals in gay and heterosexual men. *Psychology of Men & Masculinity*, *8*(1), 15.

Tiggemann, M., Polivy, J., & Hargreaves, D. (2009). The processing of thin ideals in fashion magazines: A source of social comparison or fantasy?. *Journal of social and clinical psychology*, *28*(1), 73-93.

Tod, D., Edwards, C., & Cranswick, I. (2016). Muscle dysmorphia: current insights. *Psychology research and behavior management*, *9*, 179.

Tovée, M. J., Maisey, D. S., Vale, E. L., & Cornelissen, P. L. (1999). Characteristics of male attractiveness for women. *The Lancet*, *353*(9163), 1500.

Tovée, M. J., Mason, S. M., Emery, J. L., McCluskey, S. E., & Cohen-Tovée, E. M. (1997). Supermodels: stick insects or hourglasses?. *The Lancet*, *350*(9089), 1474-1475.

Tovée, M. J., Swami, V., Furnham, A., & Mangalparsad, R. (2006). Changing perceptions of attractiveness as observers are exposed to a different culture. *Evolution and Human behavior*, *27*(6), 443-456.

Van Eeden, A. E., van Hoeken, D., & Hoek, H. W. (2021). Incidence, prevalence and mortality of anorexia nervosa and bulimia nervosa. *Current opinion in psychiatry*, *34*(6), 515.

Van den Berg, P., Thompson, J. K., Obremski-Brandon, K., & Coovert, M. (2002). The tripartite influence model of body image and eating disturbance: A covariance structure modeling investigation testing the mediational role of appearance comparison. *Journal of psychosomatic research*, *53*(5), 1007-1020.

Volpe, U., Tortorella, A., Manchia, M., Monteleone, A. M., Albert, U., & Monteleone, P. (2016). Eating disorders: what age at onset?. *Psychiatry Research*, *238*, 225-227.

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2014). Measuring attentional bias to threat: Reliability of dot probe and eye movement indices. *Cognitive therapy and research*, *38*, 313-333.

Waller, G., Hamilton, K., & Shaw, J. (1992). Media influences on body size estimation in eating disordered and comparison subjects. *British Review of Bulimia & Anorexia Nervosa*.

Want, S. C. (2014). Three questions regarding the ecological validity of experimental research on the impact of viewing thin-ideal media images. *Basic and Applied Social Psychology*, *36*(1), 27-34.

Wardle, J., & Beales, S. (1986). Restraint, body image and food attitudes in children from 12 to 18 years. *Appetite*, *7*(3), 209-217.

Webster, M. A. (2011). Adaptation and visual coding. *Journal of vision*, *11*(5), 3-3.

Webster, M. A., & MacLeod, D. I. (2011). Visual adaptation and face perception. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *366*(1571), 1702-1725.

Winkler, C., & Rhodes, G. (2005). Perceptual adaptation affects attractiveness of female bodies. *British Journal of Psychology*, *96*(2), 141-154.

Young, A. F., Gabriel, S., & Hollar, J. L. (2013). Batman to the rescue! The protective effects of parasocial relationships with muscular superheroes on men's body image. *Journal of Experimental Social Psychology*, *49*(1), 173-177.

Zhang, J., Zheng, L., & Zheng, Y. (2018). Consistency in preferences for masculinity in faces, bodies, voices, and personality characteristics among homosexual men in China. *Personality and Individual Differences*, *134*, 137-142.