Perceptions of Weight Status in Overweight and Obesity

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By

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Abstract

Individuals with overweight and obesity frequently underestimate their weight status and underestimation is more pronounced in areas with high rates of obesity. After a literature review in Chapter 1, Chapter 2 examines whether male overweight and obesity is visually underestimated and whether exposure to heavier bodies results in greater underestimation. In Study 1, 1000 participants estimated the weight status of men with normal weight, overweight and obesity in an online survey. The weight status of men with overweight and obesity was frequently underestimated. In Study 2, 90 participants reported how the size of their male peers compared to an overweight male and estimated the weight status of 10 men with overweight and obesity in a paper based survey. Those with heavier peers were more likely to underestimate overweight and obesity. Finally in Study 3, 230 participants completed a between-subjects, online study in which they were exposed to men with normal weight or obese BMI's or control images before estimating the weight status of a male with overweight. Exposure to slimmer bodies reduced underestimation of overweight. Chapter 3 examines whether male and female overweight and obesity is visually underestimated and whether visual body size norms explain why exposure to heavier bodies increases underestimation of overweight. In Study 1, 91 participants estimated the weight status of men and women with normal weight, overweight or obesity in an online survey. Male and female overweight and obesity was frequently underestimated. In Study 2, 79 participants reported visual body size norms and estimated the weight status of men and women with overweight in an online survey. Those who perceived larger bodies as being

normal were more likely to underestimate overweight. Finally in Study 3, 290 participants completed an online, between-subjects study in which they were exposed to men or women with healthy weight or obesity, reported visual body size norms and estimated the weight status of a man or woman with overweight. Those exposed to obesity reported larger body size norms and were more likely to underestimate overweight. Some research suggests underestimation of overweight could be a barrier to weight loss whilst other studies find that identifying as overweight is associated with weight gain over time. As such, Chapter 4 examines whether the psychosocial experience of feeling overweight affects eating behaviour. In Study 1, 120 women participated in a between-subjects study, they wore an obese body suit or control clothing in public or private settings before tasting and rating snack foods. Women who wore the body suit ate more than women who wore the control clothing, regardless of setting. In Study 2, 150 men and women wore an obese body suit or control clothing before tasting snack foods. Women who wore the obese body suit ate more than women who wore the control clothing. There was no effect of clothing on male consumption. We examined possible mediators of this effect but did not find supporting evidence. This thesis suggests that overweight is frequently visually underestimated due to increases in obesity increasing the range of bodies which are perceived as being normal. Furthermore, identifying as overweight may lead to increased snack food consumption, but it is not clear why this occurs. Future research should identify the mechanism explaining why feeling overweight can lead to increased consumption, as this would inform the inclusion of additional support in weight loss interventions.

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Dissemination

Conferences

The contents of this thesis have been presented at the Association for the Study of Obesity (2013), the British Feeding and Drinking Group (2014-2017), the European Association for the Study of Obesity (2015) and the International Congress on Obesity (2016).

Peer Reviewed Publications

The three studies from Chapter 2 have been published as:

Oldham, M., & Robinson, E. (2016). Visual weight status misperceptions of men: why overweight can look like a healthy weight. *Journal of Health Psychology, 21*(8), 1768-1777.

The three studies from Chapter 3 have been accepted for publication as:

Oldham, M., & Robinson, E. (In Press). Visual body size norms and the under-detection of overweight and obesity. *Obesity Science and Practice.*

The two studies from Chapter 4 have been submitted for publication as:

Oldham, M., Tomiyama A. J. & Robinson, E. (Under Review). The psychosocial experience of feeling overweight promotes increased snack food consumption in women but not men. *Appetite.*

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Chapter 1: General Introduction

1.1 The Obesity Crisis

Obesity has a substantial disease burden; it is consistently linked with poorer mental wellbeing (de Wit et al., 2010; Luppino et al., 2010; Markowitz, Friedman, & Arent, 2008; Schwimmer, Burwinkle, & Varni, 2003; Simon et al., 2008) and comorbid diseases such as diabetes, gallbladder disease and some cancers (Must et al., 1999; Pi-Sunyer, 1993) and increases the likelihood of early mortality by 22% (McGee, 2005). Alongside these personal negative health consequences, obesity also places a significant economic burden on healthcare services (Swinburn et al., 2011; Withrow & Alter, 2011).

Worldwide rates of adulthood overweight and obesity have increased dramatically over the past 30 years (Dalton et al., 2003; Flegal, Carroll, Kuczmarski, & Johnson, 1998; Flegal, Carroll, Kit, & Ogden, 2012; Groh, 2007; Ogden et al., 2006; Popkin, 2010; Rennie & Jebb, 2005). Flegal et al. (1998) used data from the National Health Examination Survey from 1960-62 and the US National Health and Nutrition Examination Surveys (NHANES) from 1971-1994 which examined national rates of obesity in US participants aged 20-74. There was a slight increase in obesity between 1960 and 1974 (the prevalence of obesity was 12.8% and 14.2% respectively), but no clear differences in obesity prevalence between the NHANES surveys from 1971-1980. There was however an 8 point increase in the prevalence of obesity in the US between 1980 and 1994 whereby the prevalence of obesity rose from 14.5% in 1980 to 22.5% in

1994 (Flegal et al., 1998) and this increased again to 32.1% by 2003 (Flegal et al., 2012). More recently obesity prevalence seems to have plateaued in the US, although obesity rates increased slightly to 34.9% in 2012 there was no significant increase in obesity prevalence between 2003-2012 (Ogden, Carroll, Kit, & Flegal, 2014). Increases in the prevalence of adulthood obesity is not limited to the US. Similar studies in UK samples have shown that obesity rates trebled between 1980 and 2002; in 1980 7% of people were obese and this rose to 24% in 2002 (Rennie & Jebb, 2005). In line with trends in the US, more recently the prevalence of obesity seems to be levelling off and in 2012 the prevalence of obesity was 25% (Health and Social Care Information Centre, 2014). Similarly, Sassi, Devaux, Cecchini and Rusticalli (2009) conducted an examination of global obesity trends in eleven countries. They used data from national health surveys and concluded that there had been sizeable increases in the prevalence of adulthood obesity across all countries from 1970-2005.

The prevalence of childhood obesity has also increased significantly in recent years (Pinhas-Hamiel & Zeitler, 2000). In 2012, more than a third of US children and adolescents were overweight and 18% of children and 21% of adolescents were obese (Ogden et al., 2014). Levels of childhood obesity are similar in the UK; in 2014-2015 32% of English children aged 10-11 and 22% of children in reception were overweight or obese (Lifestyle statistical team, 2015). Global rates of childhood obesity increased from 4.2% in 1990 to 6.7% in 2010, which is a relative increase of 60% and the prevalence of worldwide childhood obesity is expected to reach 9.1% by 2020 (de Onis, Blössner, & Borghi, 2010). The increase in both adult and child obesity poses a

considerable public health concern and means that over the course of a relatively short space of time, adiposity has gone from a rare to a relatively common condition.

1.2 Accurate Identification of Overweight and Obesity

1.2.1 Personal Weight Perception

Personal weight perceptions focus on how an individual categorises their own weight status. The accuracy of weight perceptions are examined by comparing an objective or self-reported measure of weight status (usually BMI) to a measure of perceived weight status. Perceived weight status can be measured in a number of ways; participants can be asked to categorise their weight status according to BMI (e.g. underweight, normal weight, overweight or obese) (Andrade, Raffaelli, Teran-Garcia, Jerman, & Garcia, 2012; Spencer, Appleby, Davey, & Key, 2002), whereas other studies ask participants how they would describe their weight, e.g. 'about right' or 'a little bit overweight' (Burke, Heiland, & Nadler, 2010; Duncan et al., 2011; Kuchler & Variyam, 2003; Robinson & Oldham, 2016; Yaemsiri, Slining, & Agarwal, 2011) and pictorial measures of perceived weight status have also been used (Leonhard & Barry, 1998; Maximova et al., 2008).

Robinson and Oldham (2016) examined data from the 2013 Health Survey for England and found that 54.7% of males and 30.9% of females with an objectively measured BMI that placed them in the overweight category reported their weight as being "about right". A smaller, but still significant percentage of individuals with

obesity in this study (10% of men and 4.1% of women) believed their weight status was "about right" (Robinson & Oldham, 2016). These findings are consistent with a similar large scale survey amongst US participants which found that 48.1% of men with overweight, 13% of men with obesity, 23.4% of women with overweight and 5.1% of women with obesity thought that their weight status was about right (Yaemsiri et al., 2011). Underestimation of personal weight is also evident when pictorial methods are used to measure perceived weight. Maximova et al. (2008) measured perception of weight status using the Stunkard Body Rating Scale (Stunkard, Sorenson & Schlusinger, 1983), which features seven male or female silhouettes which increase in size from underweight to obese. Participants were asked to select the silhouette which was most like their own body and this was compared to objectively measured BMI in order to examine the accuracy of weight perceptions. Although 24% of participants had overweight or obesity only 1.6% selected a silhouette that depicted an individual with an overweight or obese BMI. These studies demonstrate that a significant proportion of individuals with overweight and obesity underestimate their weight status and underestimation occurs irrespective of how perceived weight is measured.

Personal underestimation of weight has also been documented when using an alternative measure of objective weight status. Around a fifth of people with a heightened health risk according to their waist circumference thought of themselves as being about the right weight in a representative sample of English adults (Robinson & Oldham, 2016). Again, this is a very consistent finding and studies which use waist circumference as an objective indicator of health risk (as opposed to BMI) find a

slightly smaller, but still significant proportion of individuals in a higher risk category of illness who perceive themselves as being of healthy weight (Bigaard, Spanggaard, Thomsen, Overvad, & Tjønneland, 2005; Han & Lean, 2017; Spencer, Roddam, & Key, 2017; Yaemsiri et al., 2011). Although the exact rates of underestimation differ slightly based on the techniques used to measure perceived and objective weight, the tendency for individuals to underestimate their overweight and obese weight status is a very consistent finding (Ali, Amialchuk, & Renna, 2011; Andrade et al., 2012; Brug, Wammes, Kremers, Giskes, & Oenema, 2006; Burke et al., 2010; Duncan et al., 2011; Johnson, Beeken, Croker, & Wardle, 2014; Kuchler & Variyam, 2003; Niedhammer, Bugel, Bonenfant, Goldberg, & Leclerc, 2000; Nyholm et al., 2007; Spencer et al., 2002).

Whilst individuals of all ages, genders, ethnicities and socioeconomic statuses (SES) have been shown to underestimate personal overweight and obesity, there are some demographic factors that are associated with an increased likelihood of underestimation. There are gender discrepancies in misperception of weight status; overall studies suggest that males are more likely to underestimate their weight status than females (Brug et al., 2006; Chang & Christakis, 2003; Robinson & Oldham, 2016). Individuals with heavier BMIs (Niedhammer et al., 2000; Nyholm et al., 2007; Spencer et al., 2002, 2017), larger waists (Bigaard et al., 2005; Spencer et al., 2017), of lower socioeconomic status (Brug et al., 2006; Niedhammer et al., 2000) and older individuals (Brug et al., 2006; Chang & Christakis, 2003; Niedhammer et al., 2000; Nyholm et al., 2007; Spencer et al., 2017) are also more likely to underestimate their own weight

status. Finally, ethnicity can impact on underestimation, whereby Black and Hispanic individuals are more likely to underestimate weight status than Whites (Brug et al., 2006; Chang & Christakis, 2003; Dorsey, Eberhardt, & Ogden, 2010; Paeratakul, White, Williamson, Ryan, & Bray, 2002).

In summary, there is considerable evidence that a large proportion of individuals with overweight and obesity underestimate their weight and think that they are a healthier weight status than they are. This is consistent regardless of the exact measures of perceived or objective weight that are employed. Furthermore, although there are some demographic factors that increase the likelihood of underestimation, individuals with overweight and obesity from a variety of demographic backgrounds have been shown to underestimate their weight status (Ali, Amialchuk, & Renna, 2011; Andrade et al., 2012; Burke et al., 2010; Duncan et al., 2011; Johnson, Beeken, Croker, & Wardle, 2014; Kuchler & Variyam, 2003; Nyholm et al., 2007; Spencer et al., 2002).

1.2.2 Parental Recognition of Overweight and Obesity

In line with the literature which outlines personal weight misperceptions of weight status there is also evidence that parents of children with overweight and obesity frequently underestimate their child's weight status (Ali, Amialchuk & Renna., 2008; Black, Park, Gregson, Falconer, & White, 2015; Hearst, Sherwood, Klein, Pasch, & Lytle, 2011; Jeffery, Voss, Metcalf, Alba, & Wilkin, 2005; Jones et al., 2011; Katz, 2015; Lundahl, Kidwell, & Nelson, 2014; Miller et al., 2007; Parry, Netuveli, Parry, &

Saxena, 2008; Rietmeijer-Mentink, Paulis, van Middelkoop, Bindels, & van der Wouden, 2013). A recent meta-analysis revealed that in a sample of over 15,000 parents the weight status of children with overweight or obesity was underestimated 51% of the time (Lundahl et al., 2014). These findings are supported by other systematic reviews which also conclude that between 50-60% of parents underestimate the weight status of children with overweight and obesity (Parry et al., 2008; Rietmeijer-Mentink et al., 2013).

Parental underestimation of overweight seems to be particularly pronounced for younger children (Lundahl et al., 2014; West et al., 2008) but a significant proportion of parents also underestimate the weight status of older children and adolescents (Hearst et al., 2011; Rietmeijer-Mentink et al., 2013). Furthermore, in line with research on personal weight misperceptions there is evidence that parental under-detection of overweight and obesity could be affected by gender. Underestimation of overweight and obesity is higher in male children than females (De La O et al., 2009; He & Evans, 2007; Maynard, Galuska, Blanck & Serdula, 2003) and fathers are generally more likely to underestimate overweight than mothers (Jeffery et al., 2005; Remmers et al., 2014). There is also some evidence that ethnicity could impact on underestimation. A large scale study examined parental perception of child overweight or obesity and found that Black parents were more likely to underestimate child overweight relative to White parents. White parents underestimated overweight 57% of the time, whereas Black parents underestimated overweight 70% of the time (West et al., 2008). Finally, underestimation is particularly likely when a child has a BMI which is at the lower end

of overweight or obese weight status (Black et al., 2015; Lundahl & Kidwell, 2014; Miller et al., 2007).

Parents and caregivers frequently underestimate the weight status of children with overweight and obesity. Although child age, gender, ethnicity and child weight are associated with an increased likelihood of underestimation, systematic reviews demonstrate that parental recognition of overweight and obesity is generally poor regardless of demographic background, with more than 50% of childhood overweight and obesity undetected by parents (Lundahl et al., 2014; Parry et al., 2008; Rietmeijer-Mentink et al., 2013).

1.2.3 Health Care Professionals and Recognition of Overweight and Obesity

A significant proportion of individuals with overweight (74%) and obesity (29%) in the US have never been clinically diagnosed as overweight or obese and have not received weight loss advice from a Health Care Professional (HCP) according to the 2003-2008 NHANES (Yaemsiri et al., 2011). An examination of physician records from 26 medical clinics in Ireland showed that HCPs do not routinely record the height and weight of out-patients attending medical clinics, weight was objectively measured in 18.1% of cases but height was rarely recorded (1%) (Ahern, 2012). This means that identification of overweight and obesity by HCPs depends on the HCP's ability to accurately visually identify overweight and obesity in the majority of instances. If HCPs

are susceptible to the same levels of underestimation outlined above this could explain the relatively low levels of diagnosis.

A series of studies have examined the ability of HCPs to accurately identify overweight and obesity visually. Some of these studies focus on actual or simulated sessions in which the accuracy of HCPs in diagnosing obesity is examined. Bardia, Holtan, Slezak and Thompson (2007) examined the ability of HCPs to accurately estimate weight status in 2543 patients with obesity undergoing a general medical exam in America. Only 19.9% of patients with obesity were correctly given a diagnosis of obesity. Rates of identification seem to be slightly better in Europe; Bramlage and colleagues found that HCPs in Germany accurately diagnosed overweight 20-30% of the time and accuracy in identifying more severe overweight was better with 60-70% of the most obese patients (grade III obesity) being diagnosed as obese (Bramlage et al., 2004).

Other studies examine HCP's ability to recognise overweight and obesity by asking HCPs to make judgements about photographed individuals. Robinson, Parretti and Aveyard (2015) asked General Practitioners (GPs) and trainee GPs in the UK to judge the weight status of 15 photographed males (5 normal weight, 5 overweight and 5 obese). GPs are the front line of health services in the UK and see patients with a wide range of ailments, they prescribe medication and refer patients to more specific HCPs when necessary. Although accuracy was relatively high when judging the weight status of individuals with normal weight BMIs (80%), accuracy was much poorer as the BMI of the photographed males increased. The weight status of 52% of males with

overweight and 66% of males with obesity was underestimated (Robinson et al., 2015). In a similar study, Irish and Canadian HCPs were asked to visually identify the weight status of two photographed female patients. This study revealed that the weight status of an obese patient (BMI = 32) was routinely underestimated by 55% of HCPs and more than 50% of HCPs underestimated the weight status of a severely obese patient (BMI = 52) (Ahern, 2012). Again, the finding that HCPs underestimate weight status is one which is consistently supported in the literature (Andersen, Christensen, Obel, & Søndergaard, 2012; Bardia et al., 2007; Caccamese, Kolodner, & Wright, 2002; Ko et al., 2008; Lemay et al., 2003; Melamed, Nakar, & Vinker, 2009).

Alongside inaccuracies when judging the weight status of overweight and obese adults, some studies have examined the ability of HCPs to visually identify overweight and obesity in children. Barlow, Bobra, Elliot, Brownson and Haire-Joshu (2007) examined medical notes from 557 pediatrician visits in the US. They compared GP notes about the discussion of overweight and obesity with the child's BMI and found that pediatricians failed to discuss weight with 73% of children with overweight and 14% of children with obesity (Barlow et al., 2007). HCPs in the UK were also unable to accurately visually estimate childhood overweight and obesity. Smith, Gately and Rudolph (2007) showed HCPs 33 photographs of children and asked them to categorise the weight status of each child. They found that HCPs underestimated the weight status of 69% of children with overweight and 48% of children with obesity (Smith et al., 2008).

In line with personal and parental underestimation, there are some demographic factors which affect the likelihood of underestimation. Several studies have examined whether there are differences in accurate weight status categorisation based on the gender of the target. In line with personal and parental misperceptions, HCPs were particularly likely to underestimate the weight status of male patients (Ko et al., 2008; Lemay et al., 2003; Yoong et al., 2014). The weight status of both the patient and HCP was also associated with underestimation; whereby weight status was more likely to be underestimated if the patient was overweight as opposed to obese (Yoong et al., 2014) and if the HCP was overweight themselves (Perrin, Flower, & Ammerman, 2005).

1.2.4 Genuine Underestimation of Weight Status or Self-Serving Denial?

Although there is a large body of research which suggests that underestimation of weight status is common, it is not clear why underestimation occurs. Some of the discussed examples of weight status underestimation could be due to self-serving denial, as obesity is a very heavily stigmatized condition in the Western world (Puhl & Brownell, 2001; Puhl & Heuer, 2009). Thus, identifying oneself as overweight or obese may be undesirable. Similarly, parents may be apprehensive to apply a label which carries negative connotations to their child (Katz, 2015). It is even possible that the studies which focus on simulated settings for HCPs could be due to HCP bias or reluctance to discuss weight as opposed to a genuine failure to accurately recognise adiposity. Doctors can be apprehensive about engaging patients in discussions about their weight as it is a sensitive issue which could illicit an emotional or negative

response (Mikhailovich & Morrison, 2007; Müllersdorf, Zuccato, Nimborg, & Eriksson, 2010) for which they may not feel sufficiently trained (Ruser & Sanders, 2006). Furthermore, one qualitative study found that many GPs did not think obesity was a problem which required their clinical expertise and thought patients with overweight and obesity should accept personal responsibility for weight loss (Epstein & Ogden, 2005). As a result of this many GPs were unwilling to discuss treatment options with patients (Epstein & Ogden, 2005). However, there are a number of studies which still find a high rate of underestimation when HCPs were asked to estimate the weight status of individuals in photographs (Ahern, 2012; Robinson et al., 2014; Smith et al., 2008) and this shows that overweight and obesity is still underestimated when there is no risk of having to discuss it with the individual. Further work is therefore required to examine whether underestimation is solely the byproduct of bias and denial or due to a genuine inability to accurately identify overweight and obesity.

1.3 The Obese Environment and Underestimation of Weight Status

Increases in the prevalence of obesity could impact on an individual's ability to reliably recognise obesity. Several epidemiological studies have identified an association between obesity prevalence and perceived weight status (Burke et al., 2010; Duncan, Hansen, Wang, Yan, & Zhang, 2015; Johnson, Cooke, Croker, & Wardle, 2008). Although national rates of overweight and obesity rose by 10% from 1999 to 2007 in the UK, a smaller proportion of people perceived themselves as being overweight in 2007 than in 1999 (Johnson et al., 2008). Parental underestimation of overweight and

obesity may also have increased in line with the prevalence of childhood obesity. A 30% reduction in accurate parental perception of overweight and obesity was observed between 1994-2007 alongside increases in the proportion of children who were overweight and obese (Duncan et al., 2015). This decrease in accurate recognition of overweight is proportionate to a similar study which found that parents were 24% less likely to accurately categorise their overweight children as being overweight in 2005 than 10 years previously (Hansen, Duncan, Tarasenko, Yan, & Zhang, 2014). Furthermore a cross cultural study which examined lay recognition of overweight and obesity found that recognition of adiposity was less likely in countries with a higher prevalence of overweight and obesity (Robinson & Hogenkamp, 2015). Together these studies provide evidence that underestimation of overweight and obesity is more likely when the prevalence of national obesity is higher.

Alongside the national rate of obesity, there is also evidence that an individual's immediate social network may contribute to weight misperceptions whereby underestimation of overweight is more common when there is a high prevalence of obesity in the individual's local area (Binkin, Spinelli, Baglio, & Lamberti, 2013). Maximova et al. (2008) examined social networks and underestimation of personal overweight and obesity in adolescents. They found that adolescents with overweight or obesity with parents or schoolmates with obesity were more likely to underestimate their own weight status than those with mostly thin social contacts (Maximova et al., 2008). However, it is possible that some of these effects could be explained by shared environmental confounds such as SES or diet. Ali, Amialchuk and Renna (2011)

examined the influence of an individual's social network on underestimation whilst controlling for shared environmental factors. They found that mother's weight still influenced underestimation, whereby children with overweight or obesity with mothers with overweight or obesity were more likely to underestimate their own weight status than those with slimmer mothers. Having friends with overweight or obesity also made underestimation of weight status more likely when shared environmental confounds were controlled for (Ali et al., 2011). Together these studies suggest that underestimation of overweight and obesity is particularly likely in areas where individuals are more likely to see heavier bodies. Although some studies have attempted to control for shared environmental factors (Ali et al., 2011), many of these studies tend to rely on cross sectional data where the control over extraneous and confounding variables is limited.

There is some experimental evidence that supports the idea that exposure to heavier body weights can lead to greater underestimation of overweight and obese weight statuses. In a series of experiments, Robinson and colleagues examined the effect that visual exposure to different body weights had on recognition of overweight and obesity. Participants were exposed to 10 photographs of males with either normal weight BMIs or obese BMIs. After the exposure phase, participants were asked to make judgements about a male with overweight or obesity and the judgement differed dependant on the study. Individuals exposed to male obesity were more likely to rate a male with overweight as being a healthier (Robinson & Kirkham, 2014), and more attractive (Robinson & Christiansen, 2015) weight than those who were exposed to

normal weight males. Exposure to obese body weights also impacted on judgements about an obese male, whereby those who were exposed to obesity were more likely to like the appearance of a male with obesity and were less likely to judge him as being an unacceptable weight (Robinson & Christiansen, 2014). This early work suggests that exposure to heavier body weights can impact on underestimation of overweight and obesity.

1.4 Visual Underestimation and Body Size Norms

One explanation for why exposure to heavier body weights increases the likelihood of underestimation focuses on social comparison and body size norms. Social comparison processes are thought to be a critical aspect of numerous facets of decision making, informing judgements about the self (Jones, 2001; Morse et al., 1970; Mussweiler & Rüter, 2003; Mussweiler, 2003; Wilcox, & Laird, 2000) and others (Herr, 1986; Turner, 1975). Moreover, visual perception theorists suggest that when an individual is asked to make a visual judgement about a target, they compare the target to their own internal perception of what is normal (Panis, Wagemans, & Op de Beeck, 2010; Rhodes & Jeffery, 2006; Winkler & Rhodes, 2005). For example, if asked to decide whether a target is overweight, the individual making the judgement would consider what they think a normal weight looks like (an ‘internal norm’) and would determine whether the target is smaller, larger or about the same size as their ‘internal norm’. Comparisons with norms happen very frequently and are often unconscious processes (Mussweiler & Rüter, 2003).

An individual's norm is likely to be influenced by what they see around them or their 'visual diet'. Glauert, Rhodes, Bryne, Fink and Grammer (2009) demonstrated that women's body size norms are malleable and influenced by exposure to different body weights. After viewing a series of obese bodies participants reported significantly larger body size norms and after viewing underweight bodies significantly slimmer bodies were selected as being 'normal' (Glauert et al., 2009).

Visual body size norms could explain why the weight status of individuals with overweight and obesity is often underestimated. Increases in global rates of overweight and obesity (Sassi et al. 2009) means that exposure to heavier bodies is now relatively common. Frequently seeing larger bodies could have created an upward shift in terms of what is considered to be a normal body size. In turn, increases in the internal perception of body size norms could directly impact on estimation of weight status. If body size norms have increased, a target body would have to be bigger to appear larger than the norm and be considered overweight. Figure 1 depicts a pictorial representation of the proposed norm based explanation for visual underestimation of overweight and obesity.

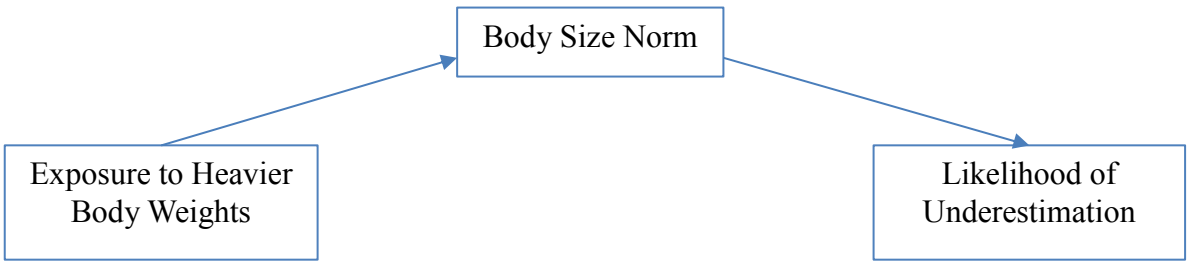

Figure 1.1 Proposed norm based model of visual underestimation of overweight and obesity.

This normative theory may explain why there are cross-cultural differences in the rate of weight misperception. Robinson and Hogenkamp (2015) found that underestimation of overweight and obesity was more likely in countries that had a higher prevalence of obesity. Participants living in countries with higher obesity prevalence would have more frequent exposure to larger bodies. According to the proposed visual norm based theory of underestimation, frequent exposure to heavier bodies could result in visual representations of what a normal body size looks like becoming larger. This could lead to greater underestimation of overweight and obesity as an overweight body may appear to be very similar to the internal norm and as such would not be judged as overweight. Although this normative theory is a credible explanation for the association between increased obesity prevalence and underestimation of overweight and obesity, it has not yet been formally tested. In this thesis I formally test whether visual exposure to heavier bodies causes an upward shift in visual body size norms and whether this in turn leads to a heightened likelihood of underestimation of overweight and obesity.

1.5 Outcomes of Underestimation

1.5.1 Ignorance is Damaging

Some researchers argue that a person not realising that they are overweight is a barrier to the adoption of healthier behaviours (Duncan et al., 2011; Jackson, Wardle, Johnson, Finer, & Beeken, 2013; Kuchler & Variyam, 2003; Wardle & Johnson, 2002). Modifying diet and physical activity, achieving weight loss and preventing future

weight gain have been argued to be determined by perceived health risk (Gregory, Blanck, Gillespie, Maynard, & Serdula, 2008) and it is commonly assumed that if a person does not identify that they are overweight then they will not perceive a risk to their health (Duncan et al., 2011; Wardle et al., 2006; Wardle & Johnson, 2002). This is in line with the Health Belief Model which states that a primary component of behaviour change is accurate subjective assessment of being susceptible to future ill health (Rosenstock, Strecher, & Becker, 1988).

There is a large body of research that examines the behavioural and psychological correlates of weight status underestimation. Accurate perception of overweight has been positively linked to weight loss intention and pursuit of weight control behaviours, such as diet or increased physical activity (Strauss, 2016; Wardle & Johnson, 2002; Yaemsiri et al., 2011). Strauss (2016) showed that perceiving oneself as overweight is a more effective predictor of weight control behaviours than actual BMI. Duncan et al. (2011) examined the effect of weight perception on weight related attitudes and behaviours in a large sample of US participants sampled during 2003-2006. Individuals with overweight and obesity who underestimated their weight status were less likely to report wanting to lose weight and less likely to have tried losing weight in the last year (Duncan et al., 2011). Similarly, male and female adolescents with overweight BMIs who underestimated their weight status were less likely to report trying to lose or maintain weight, exercising for weight control and eating less for weight control (Edwards, Pettingell, & Borowsky, 2010). Lemon, Rosal, Zapka, Borg and Anderson (2009) supported the link between underestimation and decreased interest in weight control but

also found that males and females who perceived themselves as being ‘a little bit’ or ‘moderately’ overweight were more likely to have engaged in weight loss attempts such as calorie counting or physical activity than those who thought of themselves as being ‘very overweight’(Lemon et al., 2009). The authors suggest that this could be indicative of an optimal level of awareness around weight status in terms of promoting weight change behaviours. Whereby awareness of overweight may be helpful insofar as it promotes weight loss motivation in individuals with overweight but not more severe forms of obesity.

Parental underestimation of childhood overweight and obesity could also be problematic as parental engagement is thought to be a crucial factor in promoting child weight loss. Parents often have a high level of control over a child’s diet and can limit sedentary behaviours such as TV watching (Birch, Fisher & Leann, 1998; Golan, 2006). One longitudinal study tracked a cohort of 170 parent child dyads and found that parents who accurately identified their children as being overweight or obese were more likely to encourage their child to diet than those who underestimated their child’s weight (Neumark-Sztainer, Wall, Story, & Van Den Berg, 2008). Studies also find that parents who underestimate child overweight are less likely to be concerned about their child’s weight (Tschamler, Conn, Cook, & Halterman, 2010) and less likely to attempt a weight loss intervention (Rhee, DeLago, Arscott-Mills, Mehta, & Davis, 2005; Vuorela, Saha, & Salo, 2010).

Finally, there is also some evidence that HCPs can act as agents of change in terms of promoting weight loss (Spurrier, Magarey, & Wong, 2006). Yaemsiri et al.

(2011) examined the effect of a diagnosis of overweight or obesity from HCPs on weight loss motivations and weight control behaviours in a large sample of 16,720 adults. A diagnosis of being overweight or obese from a HCP increased the odds of an individual engaging in weight control behaviours such as dieting, exercise or both (Yaemsiri et al., 2011). A HCP diagnosis of overweight or obesity is also associated with adolescents engaging in weight control behaviours; teens who had been informed about their overweight status by a HCP were more likely to have attempted weight loss and reported lower energy intake than teens who were not informed that they were overweight or obese (Kant & Miner, 2002).

Together these studies suggest that weight misperceptions can make an overweight or obese individual less motivated to attempt to lose weight (Duncan et al., 2011; Edwards et al., 2010; Tschamler et al., 2010) and less likely to be actively engaged in weight loss behaviours (Duncan et al., 2011; Edwards et al., 2010; Kant & Miner, 2002; Lemon et al., 2009; Rhee et al., 2005; Vuorela et al., 2010). However, there is some evidence that the perceived benefits of accurate weight perception are based in part on how overweight an individual feels and it is possible that those who perceive themselves as being very overweight might be less motivated to engage in weight loss behaviours (Lemon et al., 2009). Many of these studies focus on weight loss intentions. This is problematic as there is a significant intention-behaviour gap whereby intentions do not always translate in to behaviour (Sheeran, 2002). For example, a meta-analysis quantified the intention-behaviour gap for physical activity and found that only 52% of people were able to behave in line with their physical activity intentions

(Rhodes & De Bruijn, 2013). Thus, although recognition of overweight and obesity may be associated with a desire to lose weight, whether this translates to successful weight management is less clear.

1.5.2 Ignorance is Bliss

The idea that under-detection of overweight and obesity on a personal and a parental level is damaging to an individual's chances of weight loss has been the prevailing and widely supported implication in the weight perception literature for many years (Duncan et al., 2011; Kuchler & Variyam, 2003). However, more recent perspectives challenge this viewpoint. A series of studies in both adults and adolescents have demonstrated that identifying as being overweight or obese is often associated with negative outcomes. Self-perception of overweight is associated with major depression in adolescence (Kaplan, Busner, & Pollack, 1988; Roberts & Duong, 2013) and young adulthood (Al Mamun et al., 2007). Furthermore, those who perceive themselves as being overweight are more likely to report psychological distress (Atlantis & Ball, 2008), increased distress when they lose control over eating (Jones, Grilo, Masheb, & White, 2010) and are more likely to engage in binge eating behaviors (Jones et al., 2010; Saules et al., 2009).

In direct opposition to the view of weight misperceptions outlined above, there is also evidence which shows that overweight perception is associated with worse weight management. Adults who perceived themselves as overweight, relative to those who perceived themselves as being a normal weight, were at a heightened risk of weight gain

over their lifespan according to data drawn from 3 large, longitudinal studies in both the UK and US (Robinson, Hunger, & Daly, 2015). This remained the case when potential confounds such as experience of discrimination and demographic factors were controlled for. Furthermore, the link between self-identification of overweight and weight gain was not dependent on baseline BMI. Self-identification of overweight was associated with weight gain amongst individuals who had normal weight and among individuals with overweight at baseline (Robinson et al., 2015). A similar effect has been shown in adolescents, Doung and Roberts (2014) examined weight perception and weight status in adolescents over a six year longitudinal study. They found that children who perceived themselves as overweight at baseline (relative to normal weight) were approximately 2.5 times more likely to be overweight or obese at the 6 year follow up than children who thought of themselves as being a normal weight (Duong & Roberts, 2014). This relationship remained significant when baseline BMI was controlled for (Duong & Roberts, 2014). The association between feeling overweight and weight gain in adolescents was sustained over an 11 year period, whereby normal weight individuals who thought they were overweight gained more weight over this period than those who thought of themselves as being normal weight (Cuypers et al., 2012). These studies show that self-identification of overweight is associated with negative psychological outcomes and worse weight management irrespective of actual BMI. Furthermore, these studies suggest that the psychosocial experience of identifying as overweight could negatively impact on weight related behaviours and lead to weight gain over time.

However, an important limitation of these studies is that they are observational in nature and as such, the causal influence that self-identifying as being overweight has on behaviour cannot be inferred. It is possible that there is one or more additional confounding variable that explains the relationship between self-perception of overweight and weight gain. In order to examine the relationship between perceived weight, psychological outcomes and weight related behaviours in a more controlled way, some researchers have attempted to experimentally manipulate the extent to which individuals feel overweight. Ogden and Evans (1996) weighed individuals with normal weight BMIs and gave them bogus feedback about their weight status based on a fictional height and weight chart. Participants were told that they were either underweight, average weight or overweight. Those who were told they were overweight reported increases in depressed mood and reductions in self-esteem. This is in line with a similar study which examined the effect of weight labels using an experimental paradigm. Women with a normal weight or overweight BMI were measured and were randomly assigned to one of two conditions in which they were told that they were overweight or normal weight. Women who were told that they were overweight reported greater body dissatisfaction, negative affect and internalized weight stigma than women who were told that they were normal weight regardless of their objective weight status (Essayli, Murakami, Wilson, & Latner, 2016). Additionally, researchers in the US had participants wear an overweight body suit or control clothing in an attempt to experimentally manipulate whether an individual felt overweight and examined the effect that this had on eating behaviour. Participants who wore the overweight body suit

went on to eat more energy dense snack foods and drink more sugar sweetened beverages than those who wore the control clothing (Incollingo Rodriguez, Heldreth, & Tomiyama, 2016). These studies provide some preliminary empirical support for the hypothesis that feeling overweight can have a negative impact on psychological outcomes and weight related behaviours (e.g. overeating). More research is required to experimentally examine the link between perceived weight and weight related behaviors.

Parental identification of overweight and obesity has also been shown to be associated with child weight gain. Although parents in one study were more likely to encourage children to diet if they accurately identified them as being overweight this did not translate into weight loss and was actually associated with poorer weight outcomes, particularly for girls (Neumark-Sztainer et al., 2008). Parents who correctly classified their children as being overweight were also no more likely to provide more fruit and vegetables or limit fizzy drinks or calorie dense treats (Neumark-Sztainer et al., 2008). Furthermore, in a more recent study, parental perception of overweight consistently predicted greater child weight gain over an 8 year period (Robinson & Sutin, 2016). In line with similar studies in adults it did not matter if this perception was accurate and was not influenced by the actual BMI of the child at baseline (Robinson & Sutin, 2016). These studies challenge the long held belief that weight misperception among individuals with overweight or obesity serves as a barrier to weight loss and instead suggest that a failure to recognise oneself as being overweight could in fact protect against further weight gain.

1.5.3 Are Accurate Weight Perceptions Helpful or Harmful?

Based on the present literature, it is unclear whether self-identification of overweight is helpful or harmful in terms of weight management. As discussed above some studies suggest that identifying as being overweight is associated with increased intentions to lose weight (Duncan et al., 2011; Kuchler & Variyam, 2003). Furthermore, there is some evidence that parents who perceive their child as being overweight are more likely to be concerned about their child's weight status and are more likely to make some effort to intervene (Rhee et al., 2005; Vuorela et al., 2010). Finally, for many people a diagnosis of overweight may motivate them to attempt weight loss (Yaemsiri et al., 2011). However, this does not always translate into effective weight loss strategies and in some instances self-perceived overweight is associated with a reduced sense of self-control over eating (Jones et al., 2010) and weight gain over time (Duong & Roberts, 2014; Cuypers et al., 2012; Robinson & Sutin, 2016; Robinson et al., 2015). The association between perceived overweight and weight gain are often observed independently of actual BMI and do not appear to be affected by whether or not the individual is objectively overweight (Robinson & Sutin, 2016; Robinson et al., 2015). This suggests that the psychosocial experience of perceiving oneself as being overweight could impact on weight related behaviours and weight gain over time. Perceiving oneself as overweight could impact on eating behaviour and weight gain through a number of different mechanisms.

1.6 Potential Mechanisms Explaining Weight Gain as a Result of Perceived Overweight

1.6.1 Weight Stigma

A factor that may be important in explaining why self-perceived overweight can lead to weight gain is weight stigma. Weight stigma is defined as the social devaluation of people who are perceived as carrying excess weight (Tomiyama, 2014) and can encompass interpersonal experiences of stigma such as name calling, or institutionalised stigma whereby individuals with overweight and obesity are less likely to be hired or promoted (Puhl, Andreyeva, & Brownell, 2008). Puhl and Heuer (2009) found that the prevalence of weight stigma was high in a number of settings including in personal relationships, in the workplace and in medical and educational environments. Weight stigma is also evident in popular media (Greenberg et al., 2003; Heuer, McClure, & Puhl, 2011; Patterson & Hilton, 2013), whereby overweight characters are less likely to be in romantic relationships, are more likely to be ridiculed and are more likely to be engaging in out of control eating than normal weight or underweight characters (Greenberg et al., 2003). Anti-fat attitudes are very common (Puhl & Brownell, 2006) and have been documented in individuals who might not be expected to have them including very young children (Holub, 2008; Musher-eizenman, Holub, Miller, Goldstein, & Edwards-Leeper, 2003) and individuals who are overweight or obese themselves (Schwartz, Vartanian, Nosek, & Brownell, 2006; Wang, Brownell, & Wadden, 2004). Common stereotypes about individuals with obesity is that they are lazy, greedy, unhygienic and lack willpower (Brochu & Esses, 2011).

There is a common perception that weight stigma is acceptable as it may increase motivation to lose weight (Bayer, 2008; Callahan, 2013) and obesity has been labelled the last acceptable form of discrimination (Puhl et al., 2001). However, experiencing weight based discrimination is associated with increased depressive symptoms (Friedman et al., 2005; Puhl & King, 2013; Puhl & Luedicke, 2012; Rosenberger, Henderson, Robert, & Grilo, 2007), anxiety (Goldfield et al., 2010; Puhl & King, 2013) and psychological disturbance (Friedman et al., 2005; Goldfield et al., 2010). Furthermore, stigma experiences mediate the association between overweight and reduced self-acceptance (Carr & Friedman, 2005).

The negative correlates of weight stigma are not constrained to psychological health and experiencing weight based discrimination may also impact on an individual's physical health. Stigma experiences have been positively related to consumption of convenience foods (Sutin, Robinson, Daly, & Terracciano, 2016), maladaptive eating (Puhl & Brownell, 2006; Puhl & Luedicke, 2012; Wott & Carels, 2010), overeating (Sutin et al., 2016) and binge eating (Almeida, Savoy, & Boxer, 2011; Ashmore, Friedman, Reichmann, & Musante, 2008). Experience of interpersonal stigma can also compromise adherence to weight management behaviours; Wott and Carels (2010) found that women who experienced stigmatising comments from doctors or family, burnt less calories through exercise during a weight loss intervention. Sutin and Terracciano (2013) examined the association between weight stigma and weight gain over a 4 year period. They found that participants who experienced weight stigma were

2.5 times more likely to be obese and 3 times more likely to stay obese at the 4 year follow up than those who did not experience stigma.

Self-identification of overweight is likely to affect the salience of weight related stigma. If an individual identifies as being overweight then all the negative stereotypes and attitudes (Brochu & Esses, 2011) which are commonly held about individuals with overweight and obesity are relevant to them. As a result of this, those who perceive themselves as being overweight may have heightened concerns about being discriminated against or judged negatively because of their weight. This can impact on weight related behaviours, as individuals fearing negative appraisal may try to avoid stigmatizing domains such as the gym (Vartanian & Shaprow, 2008) and may be more likely to engage in comfort eating (Hunger, Major, Blodorn, & Miller, 2015). In line with this, exposure to news articles containing stigmatising anti-fat messages led to those who perceived themselves as being overweight consuming more calories and reporting lower control over eating than those exposed to non-stigmatising news articles. However, the stigmatising news articles did not have any effect on the calorie intake of those who perceived themselves as normal weight (Major, Hunger, Bunyan, & Miller, 2013).

Collectively, these studies suggest that identifying as overweight may increase an individual's sensitivity to weight stigma (Major et al., 2013). This could lead to poorer psychological and physical health outcomes as experiencing stigma is associated with negative affect (Puhl & King, 2013; Puhl & Luedicke, 2012), reduced self-esteem (Ogden & Clementi, 2010) and reduced self-acceptance (Carr & Friedman, 2005),

alongside poorer weight management behaviours such as exercise avoidance (Vartanian & Shaprow, 2008) and maladaptive eating behaviours (Almeida et al., 2011; Sutin et al., 2016).

1.6.2 Stigma Compromises Self-Control

Stigma could also affect eating behaviour and weight gain through self-control. Self-control is broadly defined as the ability to exert effortful control over behaviour in order to maintain long-term goals (Baumeister, Dewall, Ciarocco, & Twenge, 2005). Being the target of stigma has been shown to reduce self-control; Inzlicht, Mckay and Aronson (2006) found that activing stigmatising stereotypes in black and female participants led to decreases in performance on two measures of self-control. In line with this, Baumeister et al. (2005) experimentally manipulated the extent to which participants believed they were liked by other participants and examined how this affected numerous facets of self-control. Participants who were made to believe that other participants had rejected them, performed worse on measures of cognitive and attentional self-control and ate significantly more than participants who believed they had been accepted (Baumeister et al., 2005).

Social Identity Threat Theory proposes a framework to explain why experiencing stigma could result in reduced self-control (Major, Eliezer, & Rieck, 2012). Social Identity Threat Theory suggest that individuals with overweight and obesity anticipate experiencing discrimination based on their weight and experience weight based social

identity threat (Major & Brien, 2005). Weight based social identity threat is a psychological state in which an individual is worried about others making negative judgements about them and/or being discriminated against or rejected because of their weight (Hunger et al., 2015). Being in a state of weight based social identity threat is cognitively demanding and can lead to decreases in self-control (Major et al., 2012).

The strength model of self-control lends support to this view and suggests that self-control is a limited or finite resource (Baumeister, Vohs, & Tice, 2007). The strength model likens self-control resources to a muscle and suggests that exertion will lead to tiredness and temporary impairments in future tasks which require self-control, this is termed 'ego-depletion' (Baumeister et al., 2007). Many studies have used experimental paradigms to examine whether exerting self-control leads to ego depletion. This is generally achieved by allocating participants a task which requires either a high level of self-control or no self-control and then examining how performance on a subsequent measure of self-control differs between groups. Across four studies Muraven, Tice, and Baumeister (1998) found that exerting self-control (e.g. suppressing forbidden thoughts or attempting to regulate emotional responses to a sad film) led to impairments on tasks which required self-control. Furthermore, a meta-analysis which examined the effect sizes in 83 studies which examined self-control and ego depletion in similar paradigms to that described above, found a moderate to large average effect size. This meta-analysis provides support for the strength model of self-control and suggests that exerting self-control will deplete future resources (Hagger, Wood, Stiff, & Chatzisarantis, 2010). However, more recent has questioned the reliability of the ego-

depletion effect (Carter, Kofler, Forster, & McCullough, 2015; Carter & McCullough, 2014)

Individuals who self-identify as being overweight may be more likely to worry about being the target of negative judgements and may be more likely to experience social identity threat (Major et al., 2012, 2013). Anticipating or experiencing weight stigma could deplete self-control resources which could lead to impaired self-control at later occasions (Baumeister et al., 2005, 2007). This is supported by the results of an experimental study; Araiza and Wellman (2017) exposed women who perceived themselves as being overweight to newspaper articles which stigmatised against overweight or a self-irrelevant sub group (e.g. Inuit Canadians). In this study participants that perceived higher levels of weight stigma in the stigma condition performed worse on a self-control task and ordered more calories in a hypothetical dining scenario than participants in the control condition (Araiza & Wellman, 2017).

1.6.3 Stigma Increases Negative Affect

Stigma could also affect the relationship between perceived weight and weight gain through negative affect. Identifying as being overweight in a social environment which frequently degrades those with overweight and obesity (Puhl & Heuer, 2009, 2010) is likely to be unpleasant. As such, identifying as being overweight could elicit a negative emotional response which could mediate the relationship between perceived weight and weight gain. In support of this, perceived overweight is associated with greater

depressive symptoms (Roberts & Duong, 2013) and a longitudinal study found that self-perceived overweight was shown to be a significant risk factor for the development of depressive symptoms later in life (Al Mamun et al., 2007). Self-perceived overweight is also associated with negative affect (Friedman et al., 2005; Ogden & Clementi, 2010), anxiety (Puhl & King, 2013) and reduced self-acceptance (Carr & Friedman, 2005). Furthermore, negative affect has consistently been linked with overeating (Agras & Telch, 1998; Jansen et al., 2008; Schotte, Cools, & McNally, 1990; van Strien & Ouwens, 2003). Chua Touyz and Hill (2004) experimentally manipulated mood and examined the effect it had on chocolate consumption. Watching a sad film caused negative affect which resulted in participants eating more than those who watched a neutral film. Feeling overweight is likely to result in greater negative affect (Al Mamun et al., 2007; Roberts & Duong, 2013) which could promote overeating (Agras & Telch, 1998; Jansen et al., 2008). Over time this could lead to incremental weight gain.

1.6.4 Body Image

Negative body image or self-esteem could also mediate the relationship between perceived overweight and weight gain. In the Western world there is a pervasive thin ideal whereby thinness is valued, particularly for women (Spitzer, Henderson, & Zivian, 1999). Exposure to thin ideal media has been associated with greater body dissatisfaction and lower self-esteem in men and women (Hawkins, Richards, Granley, & Stein, 2004; Ogden & Mundray, 2002; Swami et al., 2010). Tiggeman (2005) showed

that girls who perceived themselves as being overweight were more likely to have low levels of self-esteem and a meta-analysis showed that perceived overweight was a better predictor of body dissatisfaction and low self-esteem than actual overweight (Miller & Downey, 1999). Low self-esteem has been linked to avoidant coping (Martyn-Nemeth, Penckofer, Gulanick, Velsor-Friedrich, & Bryant, 2009), unhealthy eating behaviours (Martyn-Nemeth et al., 2009) and binge eating (Ackard, Neumark-Sztainer, Story, & Perry, 2003). Furthermore, body dissatisfaction is associated with disordered eating (Brannan & Petrie, 2008; Bucchianeri et al., 2016). Together these studies suggest that individuals who perceive themselves as being overweight are more likely to be dissatisfied with their bodies and have lower self-esteem which could contribute to disordered eating and weight gain over time.

1.6.5 Internalisation of Negative Stereotypes

The internalisation of negative stereotypes could also mediate the relationship between perceived weight and weight gain. Unlike other 'in group' members overweight and obese individuals often hold negative stereotypes about obesity (Schwartz et al., 2006). Puhl, Moss-Racusin and Scwartz (2007) examined how internalisation of negative stereotypes about obese individuals such as laziness, overeating, binge eating and a lack of self-discipline impacted on dieting intentions in women. Women who believed and internalized negative stereotypes about obese individuals were more likely to engage in binge eating and were less likely to diet in response to stigma (Puhl, Moss-Racusin, &

Schwartz, 2007). Further evidence in support of stereotype internalisation as a mechanism comes from the perspective taking literature which suggests that taking the perspective of a stereotyped group can lead to individuals behaving in a stereotype consistent way. For example, participants asked to take the perspective of an older person walked more slowly and those asked to take the perspective of a professor had higher scores on a test of intelligence (Ku, Wang, & Galinsky, 2010). It is possible that identifying as overweight or obese could lead to the adoption of stereotype consistent behaviours such as overeating or being more sedentary.

There are several potential explanations for why self-identifying as being overweight could affect eating behaviour and further work is required to test and understand these potential mechanisms. This work may also have applied relevance because it could inform the design of intervention approaches to ensure that individuals who accurately perceive their overweight and obesity are able to make positive changes to their lifestyle and improve their health. In this thesis I will examine different mechanisms that could explain the effect that the psychosocial experience of feeling overweight has on eating behaviour.

1.7 Thesis Overview and Aims

This thesis reports three experimental chapters in which 8 studies are reported. The literature to date shows that many people with overweight and obesity (Kuchler & Variyam, 2003; Robinson & Oldham, 2016) and many parents (Lundahl et al., 2014;

Parry et al., 2008) and HCPs (Bramlage et al., 2004; Smith et al., 2008) of individuals with overweight and obesity, underestimate weight status. Based on these studies, it is not clear why weight status is frequently underestimated. The labels of 'overweight' and 'obese' carry negative connotations due to the high prevalence of weight stigma in the western world (Puhl & Heuer, 2009) and it is possible that the stigma attached to these labels results in avoidance of their use. Alternatively, it could be that under-detection of overweight and obesity is due to a genuine inability to accurately visually identify different weight statuses. Increases in the global prevalence of overweight and obesity may have created an upward shift in what is visually perceived as being a 'normal' weight. If larger body sizes are now perceived as being normal this may explain underestimation of overweight and obesity. The first two experimental chapters of this thesis examine visual under-detection of overweight and obesity and test a novel, norm based theory to explain the visual underestimation of overweight and obesity.

Chapter 2 reports three studies which aimed to examine whether the general public were able to accurately visually categorise male weight status and whether exposure to heavier body weights made visual underestimation of overweight and obesity more likely. In Study 1, a large sample of the UK general public were asked to objectively judge the weight status of photographed males in a confidential online survey. Thus, there was no apparent motive for participants to deliberately underestimate the weight status of individuals they did not know and would not meet. In Studies 2 and 3 I wanted to examine the idea that underestimation of overweight and obesity may be caused by increased visual exposure to heavier body weights. Study 2

aimed to examine whether individuals with more overweight social contacts were more likely to visually underestimate overweight and obesity. Participants indicated whether their peers were on average slimmer or larger than a male with overweight and I examined whether individuals with heavier peers were more likely to visually underestimate overweight and obesity. The effect of visual exposure to heavier body weights on weight perception was then tested experimentally in Study 3. Participants were exposed to photographed males with either normal weight or obese BMIs or control images of neutral objects before being asked to estimate the weight status of an individual with overweight.

Chapter 3 reports 3 studies which build on the findings of Chapter 2 and aimed to provide a comprehensive test of a norm based theory of the visual underestimation of overweight and obesity. In Chapter 2 I only examined visual perception of male overweight and obesity. Therefore, in Study 1 of Chapter 3 participants were asked to visually judge the weight status of photographed men and women with normal weight, overweight and obese BMIs. Study 2 aimed to comprehensively test whether body size norms were associated with underestimation of overweight. Participants were asked to make judgements about ‘normal’ body sizes and visually estimated the weight status of photographed men and women with overweight. I examined whether those who perceived larger bodies as being normal were more likely to underestimate overweight. In Study 3 I brought Studies 1, 2 and 3 from Chapter 2 and Studies 1 and 2 from Chapter 3 together. Participants were exposed to either men or women with normal weight or obese BMIs. I examined whether exposure to heavier body weights resulted

in participants reporting larger body size norms and whether this in turn led to greater visual underestimation of male and female overweight.

Based on the literature to date it is not clear whether underestimation of overweight and obesity is helpful or harmful in terms of promoting better weight management. Some research suggests that accurately identifying overweight and obesity is important as self-identification of overweight may lead to greater motivation to change behaviour and lose weight (Duncan et al., 2011; Kuchler & Variyam, 2003). However, an alternative body of research suggests that identifying as overweight or obese may actually be harmful and could lead to maladaptive eating behaviours and weight gain over time (Duong & Roberts, 2014; Robinson et al., 2015). This link between feeling overweight and weight gain occurs independently of actual BMI (Duong & Roberts, 2014; Robinson et al., 2015), which could suggest that the psychosocial experience of identifying as overweight may contribute to overeating and weight gain. However, experimental work examining the effect of the psychosocial experience of overweight on eating behaviour is currently limited. The third of my experimental chapters aims to experimentally explore the effect that feeling overweight has on eating behaviour. Furthermore, Chapter 4 aims to examine mechanisms which may explain why feeling overweight could affect eating behaviour.

In Study 1 of Chapter 4, women wore a body suit that made them appear obese or control clothing, before participating in a bogus taste test in which they were asked to taste and rate snack foods. I examined whether wearing the obese body suit impacted on snack food consumption. Specifically, whether women who wore the obese body suit

ate more than women wearing the control clothing. Study 1 also explored multiple explanations for why the psychosocial experience of feeling overweight could impact on snack food consumption. The hypothesis that feeling overweight would result in increased consumption as a result of greater concern over negative appraisal was experimentally examined by manipulating whether participants were exposed to others whilst wearing the body suit. I also examined whether changes in positive and negative affect may explain changes in eating behaviour as a result of 'feeling overweight'. Finally, I examined whether women who wore the obese body suit were more likely to implicitly identify themselves as being overweight and whether this psychological process mediated the effect of the obese body suit on snack food consumption. Study 2 of Chapter 4 built on Study 1 by examining whether the effect of feeling overweight on snack food consumption was moderated by gender. Men and women wore either the obese body suit or control clothing in a public setting before participating in the same bogus taste test as in Study 1. As well as examining whether the effect of the body suit on consumption was moderated by gender, Study 2 again tried to pin point the mechanisms underlying the effect of feeling overweight on snack food consumption. I examined whether wearing the obese body suit impacted on two measures of self-control as a result of anticipated stigma. Furthermore, I examined whether wearing the obese body suit led to decreases in self-esteem or increased concerns about physical appearance and whether either of these factors mediated the effect of the obese body suit on consumption. Finally, in Chapter 4 a meta-analysis is reported which synthesises

the data from four studies that have examined the effect of wearing an obese body suit on snack food consumption.

In summary, across 6 studies Chapters 2 and 3 of this thesis aim to examine visual underestimation of weight status and test a novel, visual norm based explanation for the widespread under-detection of overweight and obesity in men and women. The aim of Chapter 4 is to test whether the psychosocial experience of feeling overweight leads to increased snack food consumption in men and women and to evaluate the role of potential mechanisms in explaining why perceived overweight can result in overeating.

Chapter 2: Visual Weight Status Misperceptions of Men: Why Overweight Can Look Like a Healthy Weight.

2.1 Chapter Introduction

Individuals with overweight and obesity frequently underestimate their own weight status (Robinson & Oldham, 2016). In line with this, parents (Lundahl et al., 2014; Parry et al., 2008) and HCPs (Smith et al., 2008; Yaemsiri et al., 2011) frequently underestimate the weight status of children and patients with overweight and obesity. It is unclear why underestimation occurs. Underestimation could be due to a genuine inability to accurately recognise overweight and obesity. Chapter 2 examines the lay public's ability to visually identify the weight status of men. Furthermore as previous research has shown that underestimation of weight status is more likely in areas of high obesity prevalence (Robinson & Hogenkamp, 2015), Chapter 2 examines whether exposure to heavier body weights may be a cause of visual underestimation of male weight status. The research questions which are addressed in Chapter 2 are;

1) Can the lay public accurately visually recognise the weight status of men with normal weight, overweight and obesity?
2) Does exposure to heavier bodies increase the likelihood of visual underestimation of overweight?

2.2 Introduction

In recent times there has been an increase in the prevalence of obesity in most of the western world (Swinburn et al., 2011). Although the negative economic and health connotations of obesity are widely discussed (Mason, Moroney, & Berne, 2013; Tsai, Williamson, & Glick, 2011), large proportions of overweight and obese individuals underestimate their own weight status and think they are of a healthier weight than they actually are (Kovalchik, 2009; Kuchler & Variyam, 2003). The likelihood that an overweight or obese person underestimates their weight status is significantly higher among men than in women (Kuchler & Variyam, 2003; Madrigal et al., 2000). A recent meta-analysis also demonstrated that parents underestimate their overweight or obese child's weight (Parry et al., 2008) and it has also been shown that clinicians may be poor at visually recognising obesity in children (Smith et al., 2008). Parental underestimation of child weight has been shown to be more pronounced for male children (Jeffery et al., 2005).

Studies show that individuals who underestimate their own weight status may be less motivated to control their body weight (Duncan et al., 2011; Kuchler & Variyam, 2003). Likewise, a tendency to underestimate weight status in others may have public health relevance, as parents (Golan, 2006) and healthcare professionals (Spurrier et al., 2006) are important agents of change in terms of motivating healthier behaviour in others. Thus, it is important to understand the underlying causes of weight status misperceptions. Although much research has examined weight misperceptions of one's own weight status and amongst parents (Jeffery et al., 2005;

Kuchler & Variyam, 2003; Parry et al., 2008) such underestimations may be influenced by self-serving biases (Jansen et al., 2008). Moreover, we are not aware of any research that has systematically studied visual weight status misperceptions. Here we examine visual perception of weight status in others.

It is possible that weight status misperceptions have been caused by the increased prevalence of obesity. Burke, Heiland & Nadler (2010) compared national obesity rates and self-perceptions of weight status across a ten year period from 1994 to 2004. Although obesity increased in this time frame, less people identified themselves as being overweight or obese in 2004 than 1994. Overweight and obese children with obese parents or schoolmates have also been shown to be more likely to underestimate their weight status than those with mostly thin social contacts (Ali et al., 2011; Maximova et al., 2008). Similarly, exposing participants to heavier body weights increases the likelihood that participants agree an overweight man's weight looks healthy (Robinson & Kirkham, 2014).

A novel hypothesis based on these findings is that visual perceptions of what constitutes a normal or healthy weight have been recalibrated as a consequence of exposure to heavier body weights. Over time, increasing exposure to obesity may have caused individuals to adjust their visual 'anchor' of what constitutes a normal weight (Epley & Gilovich, 2015) which in turn may cause heavier body weights to appear more normal and not be classed as overweight (Johnson et al., 2008; Robinson & Kirkham, 2014). Thus, a currently untested hypothesis is that recent increases in the

prevalence of adiposity may have resulted in people adjusting their visual perceptions of what different weight statuses look like.

The aims of this work were to examine whether people visually underestimate the weight status of men with overweight and obesity and to test whether exposure to heavy body weights may be a mechanism causing visual weight status misperceptions. Given that weight status misperceptions seem to be particularly pronounced amongst men (Kuchler & Variyam, 2003; Madrigal et al., 2000) and a large proportion of men are now overweight (Flegal et al., 2012), we concentrated on visual perceptions of male weight in all studies. Study 1 examined whether a large, self-selected sample of UK participants were able to visually identify healthy weight, overweight and obese men. Study 2 tested whether frequent exposure to heavier body weights is associated with an increased likelihood to visually underestimate weight status. Study 3 built on these findings and examined whether experimentally exposing participants to different body weights impacts on weight status misperceptions. We hypothesised that participants would underestimate the weight status of overweight and obese males (Study 1) and that this tendency to underestimate may be explained by exposure to heavier body weights adjusting visual perception (Studies 2 and 3).

2.3 Study 1

2.3.1 Method

Participants

A total of 1660 participants registered interest in an online study by accessing a study website. Of these participants, 660 were excluded from final analyses for registering initial interest but then not completing the study (531) or for using a mobile phone to complete the study (129). Participants were advised not to complete the study on a mobile phone in order to keep image sizes constant. Participants were recruited via social media and through online bulletins and announcements made to staff at a large UK university. The advertisements stated participants were being invited to take part in a short study which would examine their ability to accurately recognise and categorise different weight statuses. In order to recruit a large and representative sample, no eligibility criteria were set in terms of age. The final sample of 1000 participants' age ranged from 18 to 75 years (M = 34.95 SD = 12.50). The samples (698 women and 302 men) mean body mass index (BMI) fell inside the overweight range (25.57, SD = 7.96, calculated from self-reported weight/height2). The majority of participants were Caucasian (83%). The study was approved by the authors' institutional ethics board (as were Studies 2 and 3).

Stimuli

The stimuli consisted of 15 photographs of Caucasian men aged 18-30 with varying BMI's [BMI was calculated from measured weight (kg)/height^2 (m)]. There were five

healthy weight (M BMI = 21.24, Range 19.38 - 22.40), five overweight (M = 27.23, Range = 25.65 - 28.25) and five obese (M = 31.60, Range = 30.49 - 34.32) men. The age range of photographed men was 18-30 to ensure a similar age range across the three weight statuses. We used full length photos of men with their arms at their sides wearing normal fitting short sleeved t-shirts and full length trousers. The men were dressed in order to mimic the way in which people are exposed to different body weights in everyday life. For each male two photographs were displayed; one stood front on and one side on, both next to a standardised door frame. None of the men photographed had muscular builds (according to measured body composition) as high muscle mass can confound BMI. In order to control for facial expression, the central section of each subjects face was obscured. We conducted a pilot study with 50 participants who rated the initial stimulus set on a number of scales including age, attractiveness, height, how muscular they appeared and tightness of clothing in order to select healthy weight, overweight and obese photograph sets matched for these variables. See Figure 2.1 for an example image.

Design

Participants completed an online survey in which they were asked to estimate the weight status of male models with normal weight, overweight and obese BMIs. The study was a survey and had no independent variables. The dependant variable was frequency of underestimation.

Figure 2.1 Sample photograph from overweight range.

Procedure

After providing consent, participants completed demographic information (gender, age, weight and height). They were then told they would view five photographs and be asked to make judgements about each one. Next participants were provided with World Health Organisation (WHO) BMI guidelines for underweight (< 18.5), healthy weight (18.5 - 24.9) overweight (25.0 - 29.9) and obese (≥ 30) weight statuses. Each participant was then randomly assigned (using an online pseudorandom number generator) to view five of the fifteen photographs consecutively on individual pages All but one participant saw males from at least two of the three different weight categories. Participants were asked to indicate the weight category they thought each male fell into and were also asked on a five-point Likert type scale (strongly agree to

strongly disagree). Participants were then given feedback on how accurate they were and debriefed.

2.3.2 Analysis

Accuracy rates were determined for each photograph by calculating how many people correctly identified the weight status of the photographed male. Accuracy rates were then aggregated across the five photographs of each weight status resulting in overall accuracy scores for the healthy weight, overweight and obese photos. We examined overall accuracy in order to determine whether participants were performing at an above chance level using a 2x1 chi square (chance level = 25% accuracy). Chi squares were also used to determine whether accuracy rates differed according to the weight status of the photographed male and whether weight status misperceptions tended to be caused by under- or overestimation.

2.3.3 Results

Accuracy of Weight Status Judgements

Across all photographs participants accurately categorised men as being the correct weight status 42.5% of the time, which is significantly higher than chance [X^2 (1, N = 5000) = 816.67, $p < .001$]. We then tested whether accuracy was affected by photograph weight status using a 2 X 3 Chi Square (accuracy: correct or incorrect and weight status of model: healthy weight, overweight or obese). Participants were significantly less accurate when the models were obese (13%) or overweight (38%),

as opposed to when they were a healthy weight (76%), [X^2 (2, N = 5000) = 1368.46, $p < .001$]. See Table 2.1. Thus, participants miscategorised weight status and this was particularly pronounced when judging the weight status of the overweight and obese. We also tested whether participant characteristics were associated with greater visual categorisation accuracy and found that participant weight status (accuracy: correct or incorrect and weight status of participant: underweight, healthy weight, overweight or obese) [X^2 (3, N = 4805) = .678, p = .878] and gender (accuracy: correct or incorrect and gender of participant: male or female) [X^2 (1, N = 5000) = 1.59, p = .207] did not significantly affect overall accuracy, indicating that the ability to visually recognise weight status was similar regardless of participant weight or gender. A total of 39 participants failed to provide information about their height or weight and so were excluded from analyses which examined the impact of participant body weight on visual perceptions.

Table 2.1

Number of accurate and inaccurate weight status categorisations according to the weight status of the male model being judged for Study 1

	N	Accurate Responses (%)	Inaccurate Responses (%)
Healthy Weight	1687	1280 (75.9)	407 (24.1)
Overweight	1646	625 (38.0)	1021 (62.0)
Obese	1667	220 (13.2)	1447 (86.8)

Underestimating Weight Status

We examined whether trials in which participants failed to correctly identify weight status were more likely to be due to under- or over estimation of weight status. Responses from the obese photos were excluded from this analysis as the highest weight category participants could select was obese. If there was no tendency to under or overestimate weight status, then underestimation and overestimation would occur 50% of the time for incorrect trials. Participants were more likely to underestimate than overestimate weight status [X^2 (1, N = 1428) = 1345.24, $p < .001$]; 98.5% of the time participants were wrong it was due to them underestimating weight status, whilst overestimation only occurred 1.5% of the time. A 2 x 2 Chi Square (cause of error: underestimation or overestimation and weight status of models: healthy weight or overweight) indicated that this systematic tendency to underestimate increased with weight status, [X^2 (1, N = 1428) = 28.77, $p < .001$], whereby underestimation was more pronounced for overweight men than healthy weight men. See Table 2.2.

Table 2.2

Number of over- and underestimations of weight status according to the weight status of male being judged for Study 1.

	N	Overestimate (%)	Underestimate (%)
Healthy Weight	407	17 (4.2)	390 (95.8)
Overweight	1021	4 (0.4)	1017 (99.6)

2.3.4 Conclusions

Participants were poor at visually identifying the weight status of men. This was due to a systematic tendency to underestimate weight status and this increased with the size of the individual being judged, resulting in participants judging overweight and obese men as being of healthier weight statuses than they actually were. Study 2 was designed to test whether this tendency to underestimate weight status may be explained by exposure to heavier body weights. If exposure to heavier body weights is partially responsible for visual underestimation of weight status, then individuals with heavier male peers should be particularly likely to underestimate the weight status of other men.

2.4 Study 2

2.4.1 Method

Participants

A total of 100 undergraduate students from a UK university completed a short paper-based questionnaire in exchange for course credit; 10 participants were excluded from analyses as they provided incomplete questionnaire responses. Participant age ranged from 18 to 45 years (M age = 20.19 years, SD = 3.76). The samples' (80 women and 10 men) mean BMI was in the healthy weight range [21.85, SD = 4.15, calculated from self-reported weight (kg)/height2 (m)]. We powered the study to detect a medium-sized correlation between our variables of interest at 80 per cent power (using

G*Power software). We recruited slightly above this number to account for any participants providing incomplete data.

Design

Participants completed a paper based survey. There were no independent variables. The dependant variables were size of peers, size of nonspecific males and frequency of underestimation.

Procedure

After providing demographic information participants were shown a photograph of an overweight male (BMI = 26.96) and were asked to indicate on a 10cm Visual Analogue Scale (anchors: far lighter-far heavier) how the male's weight compared to other young men they spent time with (size of peers) and how the males weight compared to other young men in general (size of non-specific others). Both of these measures were self-devised for this study. We measured both frequency of exposure to heavier body weights (size of peers) and perceptions of men in general, so we could control for the latter in analysis. In order to distract from the aims of the study participants also completed some short questionnaire measures about attitudes to overweight and obese individuals. Participants were then given the same BMI information as in Study 1 and were asked to categorise the weight status and estimate the BMI of five overweight and five obese photographed men (see Study 1). The photographs were shown on separate pages. The order in which they were presented

was randomly assigned and the same for each participant. We only included overweight and obese men, as it were these weight statuses which participants were most likely to underestimate in Study 1.

2.4.2 Analysis

To construct a sensitive measure of degree of underestimation, BMI estimates were converted into relative error scores by calculating how much participant BMI estimates differed from the actual BMI of the male in each photograph. These were then averaged to provide an average error score for all ten photographs, which reflected a participant's tendency to underestimate or overestimate weight. A negative score indicated underestimation, a positive score indicated overestimation and zero indicated perfect accuracy. Forced entry regression analysis was planned to examine whether size of peers (independent predictor variable) predicted BMI error scores (dependent variable), while accounting for size of non-specific others (other independent variable) in the same model.[1]

2.4.3 Results

Participants were poor at identifying weight status. On average, participants underestimated weight status for 8.46 (SD = 1.84) of the ten photographs, with an average underestimation of -4.98 BMI points (SD = 1.77). There was variability in responses to the size of peers measure (range = 2.60 – 9.60 on the 10-cm scale, M = 5.28, SD = 1.07) and in the size of nonspecific others measure (range = 2.50 – 6.90, M

= 4.75, SD = .88). The overall regression model was significant *F* (2, 87) = 4.57, p = .013, R^2 adjusted = .074). Size of peers was significantly related to overall BMI error [*t* = -2.92, p = .004, β = .303). For each 1 SD increase in size of peers, total error scores increased by -.303 (95% confidence interval (CI) = .161 and .844], indicating that having larger peers is associated with greater underestimation of BMI. Size of non-specific others was not associated with BMI estimation error (*t* = .23, p = .820, β = .024). There was no evidence of multi-collinearity being high in the model (both variance inflation factors <1.5).

We also examined whether participant characteristics were associated with BMI estimation error. Gender [t (88) =.166, p =.869] and participant BMI [r (89) = .022, p =.836] were not associated with overall error, but age was [r (89) = .245, p =.021]. Given that age was associated with BMI estimation error, we examined whether including age in the aforementioned regression model impacted on the relationship between size of peers and BMI estimation error. Controlling for age in the regression model did not affect the significant relationship between size of peers and BMI estimation error (t = 3.192, p = .002, β = .320).

2.4.4 Conclusions

Whether a participant had heavier male peers was associated with an increased visual underestimation of weight status of overweight and obese men, although the percentage of explained variance was relatively small (7.4%). We predicted this effect

would occur due to a greater visual exposure to heavier body weights. In Study 3, we tested this proposition experimentally.

2.5 Study 3

In Study 3, participants were exposed to images of either obese or healthy weight men or neutral objects (e.g. a sofa) and were then asked to judge the weight status of an overweight man. This paradigm was adopted from Robinson and Kirkham (2013). We hypothesised that if exposure to heavier body weights/obesity is responsible for visual underestimation, then exposing participants to images of leaner healthy weight individuals may reduce underestimation. The neutral object condition was included as a measure of baseline weight status judgements and allows us to draw conclusions about whether exposure to the healthy weight or obese men would both independently influence weight status estimation.

2.5.1 Method

Participants

A total of 230 US participants (92 women and 138 men) were recruited to take part in an online study via Amazon Mechanical Turk (MTurk). MTurk is an online platform where participants complete online tasks for a small cash sum. MTurk has been identified as a valid online recruitment method (Buhrmester, Kwang, & Gosling, 2011; Casler & College, 2014). We ensured data quality by only recruiting MTURK participants with a previous 'HIT' rate of $\geq$ 95% (Peer, Vosgerau, & Acquisti, 2014).

Participants were told they would be taking part in a 10 minute mood and perception survey. Sample size was calculated based on detecting a medium-sized effect between conditions at 95 per cent power with a $p < .05$. The samples' mean BMI fell inside the overweight range [27.70, SD = 6.91, calculated from self-reported weight (kg)/height2 (m)]. There was variability in terms of participant BMI (range = 16.03 – 65.91) with participants falling into underweight (1.7%), healthy weight (37.4%), overweight (30.4%) and obese (29.5%) ranges. Participant age ranged from 18 to 79 years (M = 34.52, SD = 11.54).

Design

Participants completed an online experiment. They were randomly assigned to one of three between-subject conditions. Dependant on condition they were either exposed to 10 photographs of males with healthy weight or obese BMIs or control images. Participants estimated the weight status of a male with an overweight BMI (dependant variable).

Procedure

After providing consent, participants were randomly assigned (using an online pseudo random number generator) to one of three conditions. They either saw 10 photographs of obese men (obese exposure, 78 participants), healthy weight men (healthy weight exposure, 77 participants) or neutral objects (control, 75 participants). The same image set was used as in Studies 1 and 2. For the first 10 photographs, participants

were asked to make a non-weight related judgement (e.g. ‘This man looks approachable’ or ‘This teapot looks cheap’ for control condition). All participants were then shown an overweight male (BMI = 28.25) and indicated whether they thought he was underweight, healthy weight, overweight or obese (as in Study 1). Participants were asked to make judgements about their mood before and after viewing the photographs in order to distract them from the true aims of the study. They were then asked to provide their own age, ethnicity and weight and height information (in their preferred unit of measurements).Participants were then asked what they thought the aims of the study were and debriefed.

2.5.2 Analysis

A 3x2 Chi Square analysis was planned in order to compare whether exposure type (healthy weight, obese, control images) impacted on accurate identification (accurate or inaccurate) of weight status. If a main effect of condition was observed we planned individual Bonferroni corrected 2x2 Chi Squares to examine differences between the exposure conditions.

2.5.3 Results

No participants guessed the true aim of the experiment (that exposure to obese vs healthy weight men would impact on weight status judgements about an overweight male). Conditions were balanced for age, gender and BMI (all $p > .05$). There was a significant effect of exposure condition on weight status categorisation of the

overweight male [X^2 (2, N = 230) = 31.44, p < .001]; 79.5% in the obese exposure condition underestimated his weight status compared to 73.3% in the control and 40.3% in the healthy weight exposure condition (See Table 2.3). Participants in the healthy weight exposure condition were less likely to underestimate weight than those in the obese exposure condition [X^2 (1, N = 155) = 26.64, p < .001] and control condition [X^2 (1, N = 152) = 16.92, p < .001]. The obese exposure and control conditions did not differ [X^2 (1, N = 153) = 1.20, p = .822]. Participant weight status [X^2 (3, N = 227) = 3.20 p = .362) and gender [X^2 (1, N = 230) = .01, p = .910] were not associated with the weight category participants believed the overweight male to be in.

Table 2.3

Number of accurate and inaccurate weight status categorisations according to the condition for Study 3.

Condition	N	Accurate Responses (%)	Inaccurate Responses (%)
Healthy Weight	77	46 (59.7)	31 (40.3)
Obese	78	15 (19.2)	63 (80.8)
Control	75	20 (26.7)	55 (73.3)

2.5.4 Conclusions

Exposing participants to healthy weight men reduced the likelihood that participants underestimated the weight status of an overweight male, in comparison to when participants were exposed to obese men or neutral objects. Exposure to leaner men

may have altered visual perceptions of what a ‘normal’ male body weight looks like (i.e. slimmer) which in turn reduced underestimation of male weight.

2.6 General Discussion

The present studies examined whether individuals are able to visually identify overweight and obesity in men and whether exposure to heavier body weights may explain visual weight status misperceptions. In Study 1, we found that people were poor at accurately recognising the weight status of men. This inaccuracy was characterised by a systematic tendency to underestimate weight status, which resulted in overweight and obese men being perceived as being of healthier weight statuses than they actually were. In Study 2, we found that participants with heavier male friends were more likely to underestimate the weight status of overweight and obese men, suggesting that more frequent exposure to heavier body weights may cause visual underestimation of weight status. This hypothesis was then tested experimentally in Study 3, and we found that exposing participants to images of healthy weight or obese men impacted on their ability to accurately categorise weight status.

The present findings indicate that exposure to obesity may result in visual weight misperceptions, whereby overweight and obese individuals appear as being of a healthier weight status than they are. One possible explanation of these findings is that exposure to heavier body weights adjusts or produces an upward shift to visual perceptions of what a ‘normal’ body weight looks like (Robinson & Kirkham, 2014).

Thus, when we are frequently exposed to obesity, overweight and obese individuals may subsequently fall into what we perceive as being the ‘normal’ body weight range and are not perceived as being overweight. The finding that participants in Study 1 systematically underestimated weight status supports this. Study 3 also provides support for this interpretation; underestimation of weight status was reduced by exposing participants to healthy weight men, which may have produced a downward shift to visual perceptions of what a normal male body size looks like.

Although much research has examined personal underestimation of weight status (Kovalchik, 2009; Kuchler & Variyam, 2003), less research has examined perceptions of other peoples’ weight status (although see Vartanian, Herman, & Polivy, 2004). As weight misperceptions about one’s own weight (and one’s child) could be motivated by self-serving bias (Katz, 2015), this work makes a novel contribution by studying visual weight status misperception in others. Our findings suggest that a significant proportion of the population may not know what male overweight and obese body weights now look like. The findings of this work also have similarities to research on personal weight misperceptions. For example, in Study 1, underestimation was particularly likely when judging overweight and obese individuals and personal weight status underestimation occurs most commonly in the overweight and obese (Kovalchik, 2009; Kuchler & Variyam, 2003). Similarly, Studies 2 and 3 suggested a social exposure component to visual weight status underestimations and some epidemiological research has hinted this may be important in explaining personal weight status misperceptions (Ali et al., 2011; Burke et al.,

2010; Maximova et al., 2008). Further work directly examining whether distorted visual perception of body weight underlies personal weight status misperceptions would now be of interest.

Turning to the findings of Study 3, participants exposed to obese men did not differ to a control condition in terms of their later weight categorisation accuracy. This may be because participants (from the United States) were already used to seeing heavier body weights in everyday life, so further exposure had little effect. However, exposure to healthy weight men did reduce weight status underestimation. This may imply that repeated exposure to information about what different weight statuses look like may reduce underestimation of weight status. Given that the identification of adiposity is thought to be important to intervention efforts (Duncan et al., 2011; Kuchler & Variyam, 2003) these findings could have applied relevance.

Strengths of the present research were that we used different methods across three studies, with both observational and experimental data supporting our hypotheses. Due to the aims of the present studies, we focused on male visual weight status judgements. How these findings relate to female weight status perceptions now warrants investigation, as there may be different social standards regarding weight status for men and women (Miller & Lundgren, 2010). One other limitation of the current research was the use of photographs throughout all studies. We used front and side on pictures, but future research could aim to replicate these findings using video footage as opposed to static images. Replicating the present studies in more diverse populations would be informative and enable us to understand whether the general

public know what ‘healthy’ and ‘unhealthy’ weight statuses look like and if correcting visual misperceptions could help improve the identification of, and intervention efforts against, obesity.

2.7 Conclusions

The findings of the present studies suggest that individuals are poor at visually identifying overweight and obesity in men and systematically underestimate weight status. A causal mechanism explaining this effect may be exposure to obesity adjusting visual perceptions of body weight.

Note

[1]We also examined whether the same pattern of results was observed when using number of times participants underestimated weight status as the main outcome variable, as well as analyses for underestimation of BMI in overweight and obese photographs separately. Regardless of the analysis method used, size of peers significantly predicted underestimation.

Chapter 3: Visual Body Size Norms and the Under-Detection of Overweight and Obesity

3.1 Chapter Introduction

In Chapter 2 I found that the weight status of men with overweight and obesity was visually underestimated. Furthermore, I found support for the hypothesis that exposure to heavier bodies increased the likelihood of visual underestimation of male overweight and obesity. Chapter 3 builds on these findings and examines whether both male and female overweight and obesity are visually underestimated. Chapter 3 also examines whether body size norms are associated with under-detection of overweight and obesity and whether visual exposure to heavier bodyweights adjusts visual body size norms and results in underestimation of weight status. The research questions addressed in Chapter 3 are;

1) Is the weight status of men and women with normal weight, overweight and obesity visually underestimated?
2) Are visual body size norms associated with visual underestimation of overweight?
3) Do visual body size norms mediate the effect of exposure to heavier bodies on underestimation?

3.2 Introduction

Although the worldwide prevalence of obesity has increased dramatically over the last 30 years (Swinburn et al., 2011), there is evidence suggesting that overweight and obesity often go undetected. Individuals with overweight and obesity consistently underestimate their own weight status (Kuchler & Variyam, 2003; Robinson & Oldham, 2016). Furthermore, a number of studies show that both parents (Jones et al., 2011; Lundahl et al., 2014) and health care professionals (HCPs) (Robinson et al., 2015; Yaemsiri et al., 2011) visually underestimate the weight status of children and patients with overweight and obesity. We propose that increases in the prevalence of obesity may have may have resulted in an upwards shift in the range of body sizes that are perceived visually as being 'normal' and that this may have resulted in widespread under-detection of overweight and obesity.

Perceptions of stimulus normality form a critical point of reference when making visual judgements (Panis et al., 2010; Rhodes & Jeffery, 2006; Winkler & Rhodes, 2005). In relation to body size, this type of 'norm comparison' process would predict that when judging whether a target body is overweight or not, this target body is compared to a person's internal visual perception of a 'normal' body size and target bodies will only be judged as being overweight if they appear larger than the 'norm'. In support of this theory, a large scale study found that accurate perception of overweight was more likely as a person's body size moved away from the population average or 'normal' body size (Wardle et al., 2006). The exact type of 'norm comparison' that is made when judging weight status is less clear. One proposal is that

when making visual judgements, stimuli are compared against an internal ‘prototype’ of what is perceived as being the average size (Panis et al., 2010). Another explanation is that body size is perceived categorically (Tovée, Edmonds, & Vuong, 2012). Thus, for each observer there may be a particular range of body sizes that are perceived as normal and it is only when a person’s body size is above the upper boundary of this ‘norm range’ that they are perceived as being overweight.

If weight status is judged according to a ‘norm comparison’ process (Robinson & Kersbergen, 2016), frequent exposure to heavier bodyweights could contribute to under-detection of overweight and obesity by recalibrating perceptions of what constitutes a ‘normal’ body size. This is because visual body size norms are likely to be based on the size of bodies we frequently see in our environment, otherwise known as the ‘visual diet’ (Brooks, Mond, Stevenson, & Stephen, 2016; Panis et al., 2010; Winkler & Rhodes, 2005). Cross-sectional data suggest that underestimation of personal weight status is more common when there is a high prevalence of obesity in the local area (Binkin et al., 2013; Maximova et al., 2008). There is also experimental evidence indicating that visual exposure to heavier bodies may increase underestimation of weight status (Robinson & Kirkham, 2014), result in greater visual preference for larger bodies (Boothroyd, Tovée, & Pollet, 2012) and increase the body sizes which are perceived as being ‘normal’ (Glauert et al., 2009). Therefore, increases in obesity prevalence may have shifted the range of body sizes that appear ‘normal’ and, in turn, impacted the visual recognition of obesity.

It has been shown that absolute body weight (e.g. in kgs) tends to be visually underestimated (Cornelissen, Gledhill, Cornelissen, & Tovée, 2016), there has been little direct experimental testing of whether the lay public can objectively visually identify overweight and obesity. Some work has suggested that male overweight and obesity tends to be visually underestimated (Oldham & Robinson, 2015; Robinson et al., 2014). However, there has been no systematic examination of visual identification of female overweight and obesity. This is of importance because there may be sex differences in the visual identification of male and female overweight and obesity. For example, parents (De La O et al., 2009; He & Evans, 2007) and HCPs (Ko et al., 2008; Yoong et al., 2014) are more likely to underestimate overweight and obesity when a person is male, as opposed to female. Furthermore, there are different cultural body ideals for men and women and more emphasis is placed on the value of thinness for women (Spitzer et al., 1999). As such, perceptions of the normal female body may be smaller than the normal male body which could result in more accurate identification of female overweight and obesity.

The manuscript examines whether exposure to obesity has led to an upwards shift in terms of what is considered a normal body size and that in turn this has led to greater visual underestimation of overweight and obesity. As far as we are aware, no studies have examined whether visual body size norms explain when overweight and obesity go visually under-detected. We conducted three experimental studies to test this theory. In Study 1 we examined whether the weight status of males and females with normal weight, overweight and obese BMIs was visually underestimated. Study

2 investigated whether body size norms explained underestimation of overweight and obesity. Finally, Study 3 examined whether visual exposure to obesity alters body size norms and whether this process leads to underestimation of overweight body sizes. We hypothesised that participants would frequently underestimate the weight status of males and females with overweight and obesity, but that the level of underestimation may be less pronounced for female, as opposed to male, overweight and obesity (Study 1). Secondly, we hypothesised that body size norms would predict underestimation, whereby those who thought larger bodies were more normal would be most likely to underestimate overweight and obesity (Study 2). Finally, we hypothesised that exposure to heavier bodies would lead to larger body size norms and this would in turn increase the likelihood of overweight body sizes being visually underestimated (Study 3).

3.3 Study 1

Study 1 was designed to examine whether members of the general public are able to accurately identify the weight status of men and women with normal weight, overweight and obese BMIs.

3.3.1 Method

Participants

103 US participants were recruited via Amazon MTURK which has been identified as a valid online recruitment method (Buhrmester et al., 2011; Casler & College, 2014).

For example, Casler and College (2014) found that data collected using Amazon MTurk was equivalent to data collected in a laboratory study and that MTurk offered a more varied sample than a traditional laboratory approach. Data quality was ensured by only recruiting MTURK participants with a previous 'HIT' rate of $\geq$ 95% (Peer et al., 2014). Participants were asked to complete the survey on a computer or laptop to avoid distortion to images and we asked people to record the device used at the end of the survey. All but one participant reported using a laptop or computer and the participant who did not was excluded from analyses along with those who did not complete the study (11 participants did not complete the study; 12 were excluded in total). The mean age of the final sample (n = 91; 47 females and 44 males) was 38.76 years (SD = 12.99, range = 19 - 70). The mean BMI (calculated from self-reported weight and height) was 27.99 (SD = 7.51, range = 16.26 – 54.29).The majority of participants were Caucasian (81.3%). The sample were generally well educated with the majority having had some experience of college or a bachelor's degree (83.6%) and the majority (58.3%) earned below $40, 000. The study was approved by the authors' institutional ethics board (as were Studies 2 and 3). Participants received remuneration for their time.

Stimuli

The stimuli consisted of photographs of Caucasian males and females with varying BMI's [calculated from measured weight (kg)/height^2 (m)]. The photographed individuals were students and staff recruited from the University of Birmingham

(men) and the University of Liverpool (women) in the UK. The models were stood next to a standard door frame, wearing normally fitting short sleeved t-shirts and full length trousers or leggings. No models had muscular builds (determined by fat mass percentage; the males had body fat >8% and the women had a body fat percentage >21%) and the central section of each model's face was obscured. In order to select standardised images of males and females for use in these three studies we conducted a pilot study where 40 US participants rated appearance related dimensions of the photographs, such as attractiveness, posture, how muscular the target appeared and tightness of clothing. We selected 21 photographs of male models and 21 photographs of female models [with equal numbers of models in the normal weight range (BMI = 18.5 - 24.9), overweight range (BMI = 25.0 - 29.9) and obese range (BMI = 30 - 39.9)] that scored similarly on these dimensions. All selected models were aged 18-40. See Table 3.1 for BMI information of the selected models and Figure 3.1 for example images.

Design

Participants completed an online survey in which they were asked to estimate the weight status of 21 male and 21 female models with healthy weight, overweight and obese BMIs. There were no independent variables. The dependant variable was underestimation scores which were calculated by aggregating how many male and female models of each weight status participants underestimated the weight status of.

Figure 3.1 Sample male and female photographs from overweight range.

Table 3.1.

Mean and range of BMI for the 7 male and 7 female models from each weight status group for Study 1.

	Male	Females
Normal weight	21.33 (18.68-23.84)	21.41 (18.75-23.63)
Overweight	27.62 (25.70-29.44)	27.64 (25.81-29.38)
Obese	31.79 (30.49-34.42)	31.71 (30.11-34.26)

Procedure

The study was advertised as being about how people make judgements about others. Participants provided digital informed consent and were given World Health Organisation (WHO) BMI guidelines for underweight (< 18.5), normal weight (18.5 - 24.9) overweight (25.0 - 29.9) obese (30 - 39.9) and severely obese (> 40) weight statuses. Participants viewed each of the 42 photographs consecutively on separate pages in a random order and were asked to estimate the weight category of each photographed person. Participants then provided demographic information (sex, age, ethnicity, height, weight, education and income) and were debriefed. Participants were allocated up to 60 minutes to complete the survey.

3.3.2 Analysis

When participants were inaccurate at categorising the weight status of the photographed models, the overwhelming majority of the time this was because they were underestimating the model's weight status (Table 3.2). Thus, our main analysis focused on underestimation of weight status. Underestimation was characterised by calculating a score out of seven to represent the number of times participants underestimated the weight status of models from each weight category (normal weight, overweight and obese men and women). A 2x3 repeated measures ANOVA was planned with sex (male or female) and weight status (normal weight, overweight or obese) of model as within subject factors and frequency of underestimation as the dependant variable. If a significant interaction was found between model sex and

weight status, we planned Bonferroni corrected t tests examining the difference between males and females with normal weight, overweight and obese BMIs separately. We also examined whether any of the main results differed when controlling for participant demographic variables that were associated with frequency of underestimation (at a conservative level of $p \leq .20$), in order to rule out any potential confounds. All data was significantly skewed according to the Kolmogorov-Smirnov test of normality (p's < .001) and the data was log transformed (as was the case in Study 2 and 3).

3.3.3 Results

Table 3.2
Percentage of underestimation, accuracy and overestimation of male and female photographs in Study 1 (N =91).

Sex	Weight Status	Underestimated (%)	Accurate (%)	Overestimated (%)
Male	Normal weight	32%	67%	1%
	Overweight	79%	21%	0%
	Obese	90%	10%	0%
Female	Normal weight	14 %	79%	7%
	Overweight	30%	60%	10%
	Obese	62%	35%	3%

Participants judged seven photographs of males and seven photographs of females from the three weight status categories.

Underestimation

See Table 3.2 for the frequency of underestimation by weight status. There was a significant main effect of model sex [$F(1, 90) = 303.88$, $p < .001$ $\eta_p^2 = .77$][1], participants underestimated the weight status of males (67%) more frequently than

females (36%). There was also a significant effect of model weight status [F (2, 180) = 303.13, $p < .001$, $\eta_p^2 = .77$], whereby the weight of obese models was more frequently underestimated (76%) than overweight (54%) ($p < .001$, $d = 2.64$) or normal weight models (23%) ($p < .001$, $d = 3.0$). The weight status of overweight models was also underestimated significantly more frequently than normal weight models ($p < .001$, $d = 2.76$). Finally, there was a significant interaction between model sex and model weight status [F (2, 180) = 48.86, $p < .001$, $\eta_p^2 = .35$]. The weight status of males was consistently underestimated more than females and the interaction was driven by a particularly large sex difference in underestimation within the overweight range (See Table 3.3 for bonferroni corrected t-tests, means and SDs). The effect of participant demographics on underestimation were also examined. Only level of education ($p = .068$) was marginally associated with frequency of underestimation. Sex ($p = .580$), age ($p = .433$), BMI ($p = .449$), income ($p = .931$) and ethnicity (this was operationalised as white or not due to the small proportions of non-white participants) ($p = .622$) were not associated with underestimation. When level of education was included as a covariate in the 2x3 ANOVA discussed above, the pattern of results was the same. The main effects of sex [F (1, 89) = 7.36, $p = .008$, $\eta_p^2 = .08$], weight status [F (2, 178) = 23.28, $p < .001$, $\eta_p^2 = .21$] and the interaction between sex and weight status [F (2, 178) = 3.60, $p = .029$, $\eta_p^2 = .04$] remained significant.

Table 3.3
Means (SD) and t-test results for underestimation scores for male and female photographs in Study 1 (N = 91).

	Female models	Male models	t-test Result
Normal weight	1.01 (.67)	2.23 (1.68)	t (90) = 7.35, p <.001, d = 0.95
Overweight	2.11 (1.81)	5.52 (1.50)	t (90) = 17.59, p < .001, d = 2.04
Obese	4.35 (1.93)	6.29 (1.03)	t (90) = 11.08, p < .001, d = 1.25

Means refer to the average number of models' weight status was underestimated for out of 7.

3.3.4 Conclusion

Participants frequently underestimated the weight status of both males and females with overweight and obesity. The frequency of underestimation was higher when the models were male, as opposed to female. Moreover, this sex difference was particularly pronounced when the models were overweight.

3.4 Study 2

Body size 'norm comparison' processes may be responsible for the visual underestimation of overweight and obesity evidenced in Study 1. A prototype explanation (Panis et al., 2010) suggests that the body size a person perceives as being 'average' affects how weight status is judged, whereby body sizes are judged in comparison to a person's perception of the 'average' body. Whereas based on visual categorisation theory (Tovée et al., 2012), there are a range of body sizes categorised as being 'normal' and how a body compares to the largest body within the 'normal range' of body sizes is critical. In Study 2, we examined whether either of these

processes predict when the weight status of males and females with overweight is visually underestimated. We focused on the overweight BMI range in Study 2 because underestimation was common in this weight range in Study 1.

3.4.1 Method

Participants

102 US participants were recruited through Amazon Turk, the same criteria were used as in Study 1 in order to ensure quality of data. Participants from Study 1 were ineligible to participate and we used the Unique Turker function to ensure that participants from Study 1 could not participate in Study 2. Participants were asked to complete the survey on a computer or laptop and all participants reported complying with this rule. Participants were excluded from final analyses if they did not complete the study (23 participants started but did not complete the study). The final sample of 79 participants (41 females and 38 males) had a mean age of 37.41 years (SD = 12.66, range = 19 - 67) and their mean BMI (calculated from self-reported weight and height) was 26.06 (SD = 5.87, range = 16.55 - 45.56). The majority of participants were Caucasian (83.5%). The sample were generally well educated with the majority having had some experience of college or a bachelor's degree (78.5%) and the majority (60.8%) earned below $40, 000. Participants received remuneration for their time.

Design

Participants completed an online survey. There were no independent variables. The dependant variables were visual body size norm judgements and underestimation scores.

Procedure

The study was advertised as being about how people make judgements about people that they do not know. Participants gave digital consent and were given the same BMI guidance as in Study 1. They then viewed fourteen photographs, featuring the same overweight models as in Study 1, in a random order on separate pages and were asked to estimate the weight status of each model. To measure body size norms, participants were shown male and female Body Size Guides (BSGs) (Harris, Bradlyn, Coffman, Gunel, & Cottrell, 2008); validated rating scales consisting of photographs of 10 standardized human bodies of increasing BMI, ranging from underweight to class III obesity (see Figure 1). Participants were asked to select the body size (for males and females separately) that they thought 'best represented an average size' and were asked to select all of the body sizes they believed 'looked normal in size'. The order in which participants completed these measures was randomized. Participants then provided demographic information (sex, age, ethnicity, height, weight, education and income) and were debriefed. Participants were allocated up to 60 minutes to complete the survey.

Figure 3.2. Female and male BSG images with rating scale (1-10) and weight status (according to objectively measured BMI) below.

3.4.2 Analysis

Underestimation was characterised by the number of photographs (out of 7), for which a participant underestimated the weight status of the model. Participants were also given scores (1 being the slimmest image and 10 being the largest) for the male and female body sizes they selected as being average (average) and the slimmest and largest body sizes they selected as falling within a normal range (lower and upper norm boundary) using the BSGs. As it is conceivable that the number of body sizes perceived as being normal could influence judgements, the width of the norm range (number of bodies selected as being ‘normal’) was also computed (norm width). To

examine differences in judgements made between males and females, sex discrepancy scores were then calculated by subtracting the male score from the female equivalent for each of the above measures.

Stepwise regression analyses were planned to compare the different norm judgments in terms of the extent to which they predicted underestimation of weight status, as this regression model automatically selects the strongest predictors and removes non-significant predictors. To examine which norm measures best predicted underestimation of weight status for men and women separately, we planned two stepwise regression analyses with the upper and lower norm boundary, average and norm width as predictor variables and frequency of underestimation as the outcome variable. In order to examine whether a discrepancy in what was perceived as being normal for men vs. women predicted why male overweight was underestimated more frequently than female overweight, a further stepwise regression model was conducted. In this model the sex discrepancy (difference in score between male vs. female models) in the upper and lower norm boundary, norm width and average body size were predictor variables and sex discrepancy in underestimation of weight status was the outcome variable. Finally, for each stepwise regression model we controlled for any demographic factors which were associated with underestimation (as in Study 1; at a conservative level of $p \leq .20$).

3.4.3 Results

Underestimation and Norm Judgements

In line with Study 1, participants underestimated the weight status of significantly more male (84%) than female (36%) models [t (78) = 17.18, p < .001, d = 2.32]. Participants believed that an average male body size (M = 4.28, SD = 1.15) was larger than the average female body size [M = 3.70, SD = 1.18; t (78) = 5.45, p < .001, d = .60]. Similarly, participants selected larger lower and upper norm boundaries for males (Lower M = 2.91, SD = 1.07, Upper M = 4.80 SD = 1.37) than females [Lower M = 2.39, SD = 1.11, Upper M = 4.24 SD = 1.60; Lower = t (78) = 5.84, p < .001 d = .54, Upper = t (78) = 5.16, p < .001, d = .36]. The width of the normal range was similar for males (M = 2.86, SD = 1.83) and females [M = 2.85, SD = 1.97; t (78) = .35, p = .726, d < .01].

Male Underestimation

The regression model examining male underestimation was statistically significant [F (1, 78) = 14.46, p< .001, ΔR^2 = .15] and the upper norm boundary was identified as a significant predictor of underestimation (B = .259, SE = .07, β = .398, t = 3.80, p < .001). The lower norm boundary, average and norm width (all p's > .05) did not predict underestimation (see Table 3.4). For each one unit increase in the upper norm boundary, frequency of underestimation increased by 4%. There was no evidence of significant multicollinearity [variance inflation factor (VIF) < 3]. In order to be sure that demographic factors were not influencing underestimation, we also examined

whether any of the main results differed when controlling for participant demographic variables that were associated with underestimation at $p \leq .20$. For male underestimation; neither sex ($p = .273$), age ($p = .543$), ethnicity (white or not) ($p = .680$), education level ($p = .980$), income ($p = .905$) or BMI ($p = .895$) were associated with underestimation at $p \leq .20$, so no further analyses were conducted.

Female Underestimation

The regression model examining female underestimation was statistically significant [$F (1, 78) = 18.05$, $p < .001$, $\Delta R^2 = .18$]. The upper norm boundary was identified as a significant predictor of underestimation ($B = .417$, $SE = .10$, $\beta = .436$, $t = 4.25$, $p < .001$). The lower norm boundary, average and norm width (all p's > .05) did not predict underestimation (Table 3.4). For each one unit increase in the upper norm boundary, frequency of underestimation increased by 6%. There was no evidence of significant multicollinearity (VIF < 3). Education ($p = .043$), BMI, ($p = .039$) and income ($p = .137$) were associated with underestimation at $p \leq .20$, whereas sex ($p = .491$), age ($p = .401$) and ethnicity (white or not) ($p = .576$) were not. After controlling for BMI, education and income, the upper norm boundary was still a significant predictor of underestimation [$B = .417$, $SE = .10$, $\beta = .436$, $t = 4.25$ $p <.001$].

Sex discrepancy in Underestimation

The regression model examining sex discrepancy in underestimation was statistically significant [$F (1, 78) = 8.65$, $p = .004$; $\Delta R^2 = .09$]. The upper norm boundary

discrepancy was identified as a significant predictor of underestimation discrepancy (B = .398 SE = .14, β = .318, t = 2.94, p = .004). The lower norm boundary discrepancy, average discrepancy and norm width discrepancy (all p's > .05) did not predict underestimation discrepancy (Table 3.4). For every one unit difference between male and female upper norm boundaries, the tendency for male overweight to be underestimated more than female overweight increased by 5%. There was no evidence of significant multicollinearity (VIF < 3). Sex (p = .173), education (p = .035), income (p = .159) and BMI (p = .023) were associated with the sex discrepancy in underestimation at p ≤ .20, whereas age (p = .216) and ethnicity (white or not) (p = .995) were not. After controlling for sex, education, income and BMI, the discrepancy in upper bounds was still a significant predictor of the discrepancy in underestimation [B = .398, SE = .14, β = .318, t = 2.94, p = .004].

Table 3.4
Standardized Beta, t values and p values for non-significant predictors in the stepwise regression models for male and female underestimation and the discrepancy in underestimation in Study 2 (N = 79).

	Upper Norm Boundary	Lower Norm Boundary	Average	Norm Width
Underestimation of male overweight	B = .259, t = 3.80, p < .001	B = .095, t = .90, p = .369	B = -.040, t = .36, p = .723	B = -.141, t = .90, p = .374
Underestimation of female overweight	B = .417, t = 4.25, p < .001	B = .186, t = 1.84, p = .069	B = .213, t = 1.93, p = .057	B = -.297, t = 1.92 p = .059
Discrepancy between underestimation of male and female overweight	B = .398, t = 2.94, p = .004	B = .154, t = 1.29, p = .200	B = .099, t = .87 p = .386	B = -.167, t = 1.22, p = .225

3.4.4 Conclusion

In line with Study 1, the weight status of males and females with overweight was frequently underestimated. The results of Study 2 supported a categorisation theory of body norms and weight status underestimation (Tovée et al., 2012). Our results suggest that there are a range of body sizes that are perceived as being normal in size and when a target body is bigger than the largest body size in this 'norm range' (the 'upper norm boundary'), underestimation of weight status is more likely to occur. Furthermore, sex differences in this 'upper norm boundary' was associated with male overweight being more frequently underestimated than female overweight; the largest body size perceived as being 'normal' was bigger for men than women.

3.5 Study 3

The aim of Study 3 was to directly examine the hypothesis that exposure to obesity results in an upwards shift in the range of body sizes that are perceived as being 'normal', resulting in visual underestimation of weight status. Based on the findings of Study 2, it was expected that exposure to obesity would result in an upwards shift in the largest body size perceived as being normal (the upper norm boundary), leading to increased underestimation of weight status. In Study 3, some of the potential limitations associated with the stimuli used in Studies 1 and 2 were addressed. The images in the first two studies were not fully standardized (e.g. participant clothing varied between stimuli). Although we believe it is unlikely that these factors would have affected the pattern of results observed, ideally stimuli should be as standardized

as is possible in terms of both clothing and colour (Swami, Salem, Furnham, & Tovée, 2008). As such, we presented stimuli in Study 3 in greyscale and standardised images were taken from a the BSG; the validated body image scale used in Study 2 (Harris et al., 2008).

3.5.1 Method

Participants

Because Study 3 involved an experimental manipulation, we recruited a larger sample size and powered the study to detect medium sized between-subjects effects (Robinson & Kirkham, 2014). Three hundred and twenty four US participants were recruited via Amazon Mechanical Turk and Unique Turker was used to ensure that participants who took part in Studies 1 and 2 did not take part in Study 3. The same criteria was used as in Study 1 and 2 in order to ensure quality of data. Participants who failed to complete study instructions (34 participants) were excluded from analyses. Participants were asked to complete the survey on a computer or laptop and received remuneration for their time. The final sample of 290 participants (174 females and 116 males) had a mean age of 35.55 years (SD = 12.40, range = 18 - 77) and a mean BMI of 28.66 (SD = 9.59, range = 14.68 - 74.45). The majority of participants were Caucasian (76.9%), had some experience of college or a bachelor's degree (72.7%) and earned below $40,000 (60%).

Design

Participants completed an online experiment. They were randomly assigned to one of four between-subject conditions. Dependant on condition they were either exposed to 10 photographs of men or women with healthy weight or obese BMIs. Participants reported visual body size norms and estimated the weight status of a man or woman with an overweight BMI (dependant variables).

Procedure

Participants were told that the aim of the study was to examine how personality impacted on judgements about others. After providing consent, participants provided demographics (sex, age, ethnicity, height, weight, education and income) and completed personality questions (e.g. 'I am an outgoing person') to distract from the study aims. Participants either made ratings about images of males or females (between-subjects). In the exposure phase of the experiment, participants were exposed to 10 images of BSGs (see Figure 1) with either normal weight (BMI = 18.5 – 24.9) or obese (BMI 35-39.9) BMIs (between-subjects) on consecutive pages and were asked to make one non weight related judgements about each image (e.g. 'he/she looks like he/she would be kind'). This procedure allowed us to visually expose participants to different body sizes in a way that corroborated the study cover story. Participants then completed the norm judgement questions as in Study 2 [BSGs (Harris et al., 2008)]. Finally, participants were asked to estimate the weight status of an overweight male or female BSG (the sex of the overweight BSG being evaluated

was the same as the sex of BSGs participants were exposed to). The presentation of the norm and weight judgement tasks was counterbalanced. Participants were then asked to guess the aims (none of the participants accurately guessed the aims of the study) and were debriefed. Participants were allocated up to 60 minutes to complete the survey.

3.5.2 Analysis

We conducted separate analyses for judgements about females and males. A series of t tests were planned to examine whether exposure condition (normal weight or obese) impacted on judgements about norms (upper norm boundary, lower norm boundary, average and norm width) and chi squares were used to examine whether exposure condition impacted on frequency of underestimation. We next planned binary logistic regression analyses to examine whether any of the norm judgements that differed significantly between exposure conditions were independently associated with underestimation. If this was the case, we planned to run PROCESS mediation analyses (Hayes, 2013) in order to examine whether the effect of exposure to obesity on underestimation of weight status was mediated by alteration to body size norm measures. In order to examine whether results were consistent, we controlled for any demographic factors which were associated with underestimation (at a conservative level of $p \leq .20$) in the mediation analyses.

3.5.3 Results

The Effect of Exposure on Judgements about Females

Participants who were exposed to females with obesity later underestimated the weight status of the female with overweight (43%) significantly more than participants who were exposed to normal weight females (13%). Furthermore, participants exposed to females with obesity chose a larger body size as being the largest body that fell within the 'normal' range (upper norm boundary) than participants exposed to normal weight females. Participants in the obese exposure condition also selected a larger 'average' body size and had a borderline significantly larger norm width than participants in the normal weight exposure condition. Lower bound judgements did not differ between exposure conditions (See Table 3.5 for Chi Square and t test results).

In the binary logistic regression model, upper norm boundary (B = -9.391, SE = 2.50, $p < .001$) and norm width (B = -3.084, SE = 1.17, p = .008) were significantly associated with underestimation, whereby a larger upper norm boundary and norm width predicted underestimation. The average norm was not associated with underestimation (B =.576, SE = 1.78, p = .746). In the parallel PROCESS mediation model, the upper norm boundary significantly mediated the relationship between condition and underestimation (B = -.675, Bca CI's = -1.69, -.10) whereas norm width did not (B = .337, Bca CI's = -.01, 1.19; see Figure 3.3). Participants who were exposed to heavier female bodies reported larger upper norm boundaries which led to the increased likelihood of underestimation. Participant age (p = .008), education (p <

.001) and BMI (p = .025) were all associated with underestimation at a level of p ≤ .20, whereas sex (p = .550), income (p = .865) and ethnicity (white or not) (p = .582) were not. When age, education and BMI were included as covariates in the parallel mediation model described above the pattern of results did not change. The upper norm boundary still mediated the relationship between condition and underestimation when age [B = -.626, Bca CI's = -1.54, -.03], education [B = -.721, Bca CI's = -1.94, -.06] and BMI [B = -.645, Bca CI's = -1.64, -.08] were included as covariates.

The Effect of Exposure on Judgements about Males

Underestimation tended to be more common after being exposed to males with obesity (92%), as opposed to normal weight males (83%). This did not reach statistical significance (p = .097) but this may be due to the high prevalence of underestimation in both conditions. Participants exposed to obesity selected a larger body as the upper norm boundary and a larger body size as being average, as well as selecting a wider norm width. Exposure condition had no impact on the lower norm boundary (Table 3.5).

In the binary logistic regression model, upper norm boundary (B = -.12.266, SE = 4.01, p = .002) and average norm (B = -5.066, SE = .226, p = .025) were significantly associated with underestimation, whereby a larger upper norm boundary and average predicted underestimation. Norm width was not associated with underestimation (B = 1.940, SE = 1.86, p = .298). In the parallel PROCESS mediation model a significant indirect effect of condition on underestimation through the upper

norm boundary was observed (B = -.694, Bca CI's = -1.41, -.24), as well as through the average norm (B = -.330, Bca CI's = -.85, -.03; See Figure 3.4). Participants who were exposed to heavier male bodies reported larger upper norm boundaries and larger average norms, which led to the increased likelihood of underestimation. Participant ethnicity (white or not) ($p = .011$) and age ($p = .041$) were associated with underestimation at a level of $p \leq .20$, whereas sex ($p = .976$), income ($p = .438$) education ($p = .267$) and BMI ($p = .656$) were not. The indirect effects of both the upper norm boundary [ethnicity = B = -.664, Bca CI's = -1.36, -.23; age = B = -.579, Bca CI's = -1.20, -.17] and the average [ethnicity = B = -.307, Bca CI's = -.82, -.01; age = B = -.300, Bca CI's = -.78, -.02] remained significant when ethnicity and age were included as covariates in the parallel mediation model.

Table 3.5
The effect of experimental exposure condition on norm judgements and underestimation in Study 3.

	Normal weight Exposure	Obese Exposure	Test Results
Females (N = 142)	(N = 68)	(N = 74)	
Upper norm boundary	4.66 (2.28)	5.28 (1.97)	t (140) = -2.31, p = .022, d = .37
Lower norm boundary	2.18 (1.01)	2.31 (1.38)	t (140) = -.08, p = .935, d = .01
Average	3.60 (1.07)	4.32 (1.29)	t (140) = -3.36, p = .001, d = .52
Norm width	3.47 (2.72)	3.91 (2.17)	t (140) = -1.92, p = .057, d = .33
Underestimation of weight status	9 (13%)	32 (43%)	X^2 (1, N = 142) = 15.54, p < .001, V = .33
Males (N = 148)	(N = 75)	(N = 73)	
Upper norm boundary	4.56 (1.50)	5.52 (1.98)	t (146) = - 3.27, p = .001, d = .50
Lower norm boundary	2.67 (0.88)	2.74 (1.01)	t (146) = -.048, p = .962, d = .01
Average	4.18 (1.10)	4.78 (1.19)	t (146) = -3.20, p = .002, d = .50
Norm width	2.88 (1.82)	3.78 (2.42)	t (146) = -2.12, p = .036, d = .35
Underestimation of weight status	62 (83%)	67 (92%)	X^2 (1, N = 148) = 2.75, p = .097, V = .14

For upper norm boundary, lower norm boundary and average, values refer to body sizes selected using BSG scales and are M(SD). Norm width refers to number of body sizes selected using BSG scales are M(SD). Underestimated refers to number of participants underestimating the weight status of the overweight model [frequency(%)].

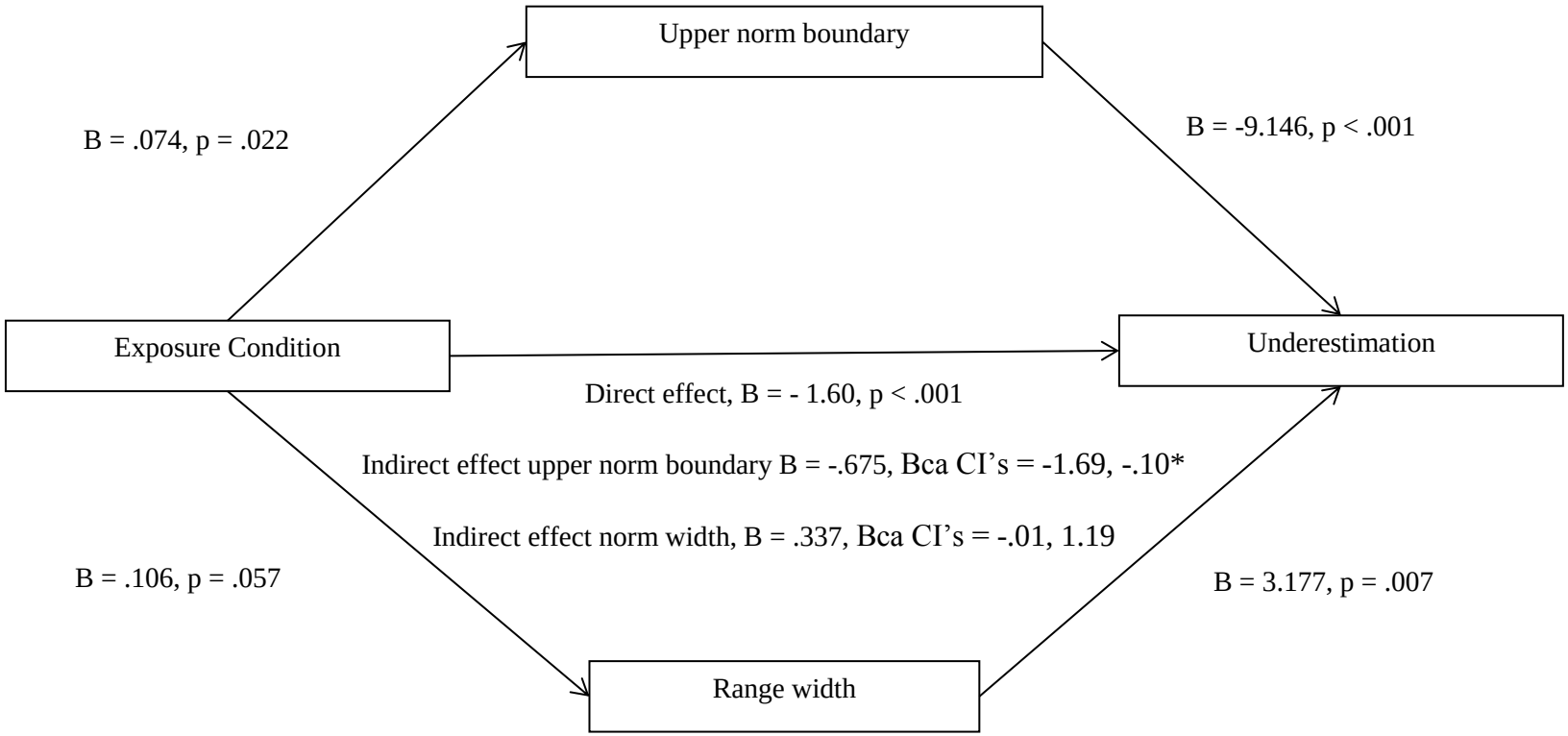

Figure 3.3 Model of exposure condition as a predictor of underestimation mediated by upper norm boundary and range width in women in Study 3.

Notes: The confidence interval for the indirect effect is a BCa bootstrapped CI based on 1000 samples. * Indicates statistical significance.

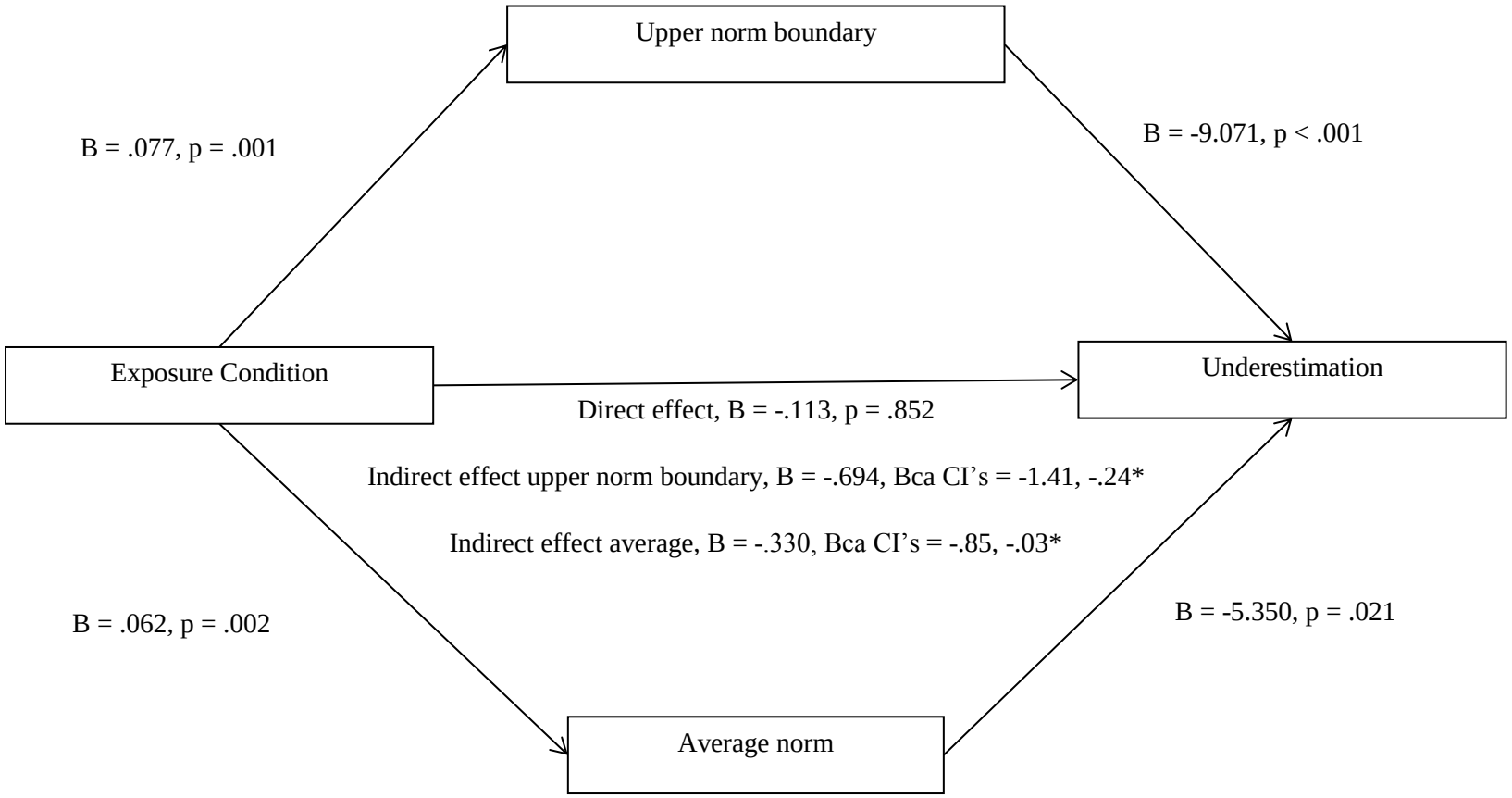

Figure 3.4 Model of exposure condition as a predictor of underestimation mediated by upper norm boundary and average norm in men in Study 3.

Notes: The confidence interval for the indirect effect is a BCa bootstrapped CI based on 1000 samples. *Indicates statistical significance.

3.5.4 Conclusion

Visual exposure to obesity shifted the range of body sizes perceived as being ‘normal’ upwards and this acted as a mediator in explaining the effect of exposure to obesity on visual underestimation of overweight. Norms regarding what an average weight looked like also mediated the relationship between exposure to obesity and underestimation when judging the weight of male, but not female overweight.

3.6 General Discussion

The present studies suggest that overweight and obesity are under-detected visually which may be caused by exposure to larger body sizes having changed the range of body sizes which are perceptually judged as being ‘normal’. Our findings support a ‘norm comparison’ theory of the underestimation of weight status. This theory suggests that bodies that are perceived as being outside of the range of body sizes that are considered to be normal will be judged as being overweight. The increased prevalence of obesity is likely to have resulted in heavier body sizes being perceived as being ‘normal’. These findings could explain why visual underestimation of obesity is more common in countries with a higher obesity prevalence (Robinson & Hogenkamp, 2015) and why individuals with overweight peers are more likely to underestimate their own weight status (Maximova et al., 2008).

Previous work has found that male overweight and obesity is visually underestimated (Robinson & Hogenkamp, 2015; Robinson & Oldham, 2016; Robinson et al., 2014) and here we also found this to be the case for female

overweight and obesity. However, we found that the weight status of males with overweight was more likely to be underestimated than that of females. Media influence could be partly responsible for the sex discrepancy in underestimation as female models and actresses are more likely to be slender than males (Greenberg et al. 2003; Leit, Pope, & Gray, 1999) and there is a persuasive western 'thin ideal', whereby thinness is valued more positively and presented more frequently for females than males (Spitzer et al., 1999) . These factors are therefore likely to result in thinner body sizes appearing more normal for females than males, as was the case in Study 2. In line with this, there is evidence that women are more likely to overestimate their weight status than men (Brug, Wammes, Kremers, Giskes & Oenema, 2006; Park, 2011). Future research should examine the separate and combined effects of exposure to heavier and slimmer bodies in the media and in everyday life on body size norms and perception of weight.

The implications and applied relevance of the present studies now require further attention. Some researchers suggest that a failure to identify overweight and obesity in others could be a barrier to weight loss, as family members (Golan, 2006) and clinicians (Spurrier et al. 2006) could be important agents of change in terms of promoting healthier behaviours. Parents who underestimate child overweight are less likely to be concerned about their child's weight (Tschlamer, Conn, Cook & Halterman, 2010) and are less likely to attempt a weight loss intervention (Vuorela, Saha & Salo, 2010; Rhee, DeLago, Arscott-Mills, Mehta & Davis, 2005). Furthermore, GPs are less likely to discuss weight loss interventions with patients when they underestimate the patients

weight (Robinson et al., 2014). These studies are suggestive of a need for more accurate recognition of overweight and obesity. This could be achieved by training parents and HCPs to recognise body size norms which represent a healthier weight.

Conversely, an emerging literature may suggest otherwise, as accurate identification of being overweight has been shown to be associated with a number of adverse outcomes, including greater body dissatisfaction (Miller & Downey, 1999), depression (Al Mamun et al., 2007) and weight gain (Robinson & Sutin, 2016; Robinson et al., 2015). These findings are consistent with a broader literature on obesity and body satisfaction which shows that many individuals with obesity report higher body dissatisfaction (Sarwer, Wadden & Foster, 1998; Sarwer, Thompson & Cash, 2005) which can impact on self-esteem and depression (Sarwer et al., 1998). These findings are likely to be at least in part due to the stigma of obesity (Puhl & Brownell, 2001; Puhl & Heuer, 2009; Puhl & Heuer, 2010) which could make identifying as being overweight or obese unpleasant. One solution to this would be to ensure that weight information is relayed to patients in a sensitive and non-stigmatising way and to build stigma reduction techniques into future weight loss interventions. Furthermore, different strategies for reducing the potentially negative effects that self-perceived overweight can have on body satisfaction, weight related behaviours and weight gain may warrant investigation.

Limitations

A limitation of the present studies was that our sample was predominantly Caucasian (81% average across the 3 studies). Similarly, the models used as stimuli in the studies were Caucasian. Some studies suggest that identification of overweight (Dorsey et al., 2010) and body norms (Kemper, Sargent, Drane, Valois, & Hussey, 1994) can be affected by ethnicity, so further work in more diverse samples would now be valuable. It may also be the case that overweight and obesity are more easily detected in person than when using photograph stimuli and this may have resulted in poorer identification of weight status in the present studies. However, it should be noted that there is convincing evidence of widespread under-detection of overweight and obesity when judgements are made in person (Bramlage et al., 2004; Christensen, 2016). As all three studies were conducted online a further limitation could be reduced control over participant responses. However, we used a number of procedures to limit this concern; we sampled only reliable participants from MTURK (determined by their previous approval ratings) and included attention checks to detect whether participants were completing our studies as intended. Finally, there may be some limitations associated with the photographic stimuli used in Studies 1 and 2. We attempted to standardise the BMI and appearance of the models but the male and female photograph sets used in Studies 1 and 2 are not perfectly matched (e.g. in terms of the clothing worn by models). However, the same pattern of results observed in studies 1 and 2 was observed in Study 3 where the images used were standardised.

3.7 Conclusions

Overweight and obesity are under-detected visually. The visual under-detection of overweight and obesity may be in part caused by exposure to obesity changing the range of body sizes that are perceptually judged as being ‘normal’.

Notes

[1]Data was log transformed throughout due to skewed data. Inferential statistics (including effect sizes) were conducted on log transformed data. Means that are reported are based on the non-transformed data for ease of interpretation.

Chapter 4: The Psychosocial Experience of Feeling Overweight Promotes Increased Snack Food Consumption in Women but not Men

4.1 Chapter Introduction

Chapters 2 and 3 of this thesis provide comprehensive support for a norm based theory of underestimation. I next aimed to understand what the implications are of perceiving one's own weight status as being overweight. Some research suggests that self-identification of overweight is associated with greater motivation to change behaviour and lose weight (Duncan et al., 2011; Edwards et al., 2010). Furthermore accurate identification of overweight by parents (Birch, Fisher & Leann, 1998; Golan, 2006) and HCPs (Spurrier et al., 2006; Yaemsiri et al., 2011) is thought to increase weight loss intentions for children and patients with overweight and obesity. However, a recent body of work suggests that self-identification of overweight is linked with worse weight management and weight gain (Duong & Roberts, 2014; Robinson et al. 2015). Chapter 4 examines whether the psychosocial experience of feeling overweight affects snack food consumption and evaluates potential mechanisms which may explain why feeling overweight can affect consumption. The research questions addressed in Chapter 4 are;

1) Does the psychosocial experience of feeling overweight result in increased snack food consumption in women and men?
2) Does affect, implicit or explicit perception of overweight, self-presentation concerns, body image concerns, self-esteem or self-control mediate the effect of the psychosocial experience of overweight on snack food consumption?

4.2 Introduction

Weight stigma is defined as the social devaluation of people who are perceived as carrying excess weight (Tomiyama, 2014). Weight stigma is pervasive and has been documented in both institutional (e.g. organisational culture of negative attitudes) and interpersonal (e.g. name calling) settings (Puhl, Andreyeva, & Brownell, 2008), in occupational, educational, healthcare and personal contexts (Puhl & Brownell, 2006; Puhl & Heuer, 2009). Weight stigma is also evident in the mass media (Greenberg et al., 2003; Heuer et al., 2011; Patterson & Hilton, 2013).

Pervasive weight stigma is likely to make identifying as being overweight or obese an unpleasant experience. For example, regardless of objective weight, individuals who self-perceive their weight status as being overweight experience increased levels of psychological distress compared to those who do not (Atlantis & Ball, 2008). Furthermore, self-identification of overweight (as opposed to normal weight) has been shown to be associated with stress induced overeating and weight gain in three large scale studies of UK and US participants (Robinson et al., 2015). The association between self-identification of overweight and weight gain occurred whether personal perception of overweight was accurate or inaccurate (Robinson et al., 2015). This and other studies (Duong & Roberts, 2014; Sutin & Terracciano, 2015) suggest that the psychosocial experience of self-identifying as being overweight is associated with worse weight management. Yet, an important caveat of these studies is that they are observational in nature, so the causal influence that self-identifying as being overweight has on behaviour cannot be inferred.

Manipulating the psychosocial experience of self-identifying as being overweight or obese and examining its effect on behaviour is therefore required to understand the causal

role that identifying as being overweight has on weight related behaviours. In a novel study, researchers examined the effects of experimentally manipulating apparent weight status in order to examine how the psychosocial experience of feeling overweight impacted on eating behavior (Incollingo Rodriguez et al., 2016). Participants wore an obese body suit or control clothing and performed a task which required them to walk around a busy University campus, before being given access to calorie dense snack foods and sugar sweetened beverages. Those who wore the obese body suit experienced greater negative affect, ate more of calorie dense snack foods and drank more of a sugar sweetened beverage than participants who wore control clothing (Incollingo Rodriguez et al., 2016). This study suggests that the psychosocial experience of feeling overweight can result in increased calorie consumption.

Heightened concerns about appearance or fear of negative appraisal could explain why identifying as overweight could impact on eating behaviour. Individuals with overweight and obesity are likely to experience weight based social identity threat (Major & Brien, 2005; Shapiro & Neuberg, 2007); a psychological state in which an individual is worried about others making negative judgements about them because of their weight (Hunger et al., 2015). Majors, Hunger, Bunyan and Miller (2013) found that after reading a weight stigmatising article, women who self-identified as being overweight ate more than women who were exposed to a neutral article. However, a weight stigmatising article, relative to a neutral one, did not lead to increased calorie consumption in women who self-identified as being of healthy weight (Major et al., 2013). Likewise Inzlicht and Kang (2010) found that women consumed more of a calorie dense snack food when they were given no strategies to cope with social identity threat than when they were given techniques aimed at reappraising threats. These studies suggest that the experience of

feeling overweight or obese could increase fear of negative evaluation and this could in turn lead to increased consumption.

Another potential explanation for the link between the experience of feeling overweight and eating behaviour is negative affect (Tomiyama, 2014). Due to high levels of weight stigma (Puhl & Heuer, 2009), identifying as overweight or obese is associated with reduced self-acceptance (Carr & Friedman, 2005) and could increase negative affect. Self-identification of overweight has been associated with increased depressive symptoms (Roberts & Duong, 2013) and there is a wealth of literature which suggests that negative affect can result in increased calorie consumption (Agras & Telch, 1998; Jansen et al., 2008; Schotte et al., 1990). For example, Chua Touyz and Hill (2004) experimentally manipulated affect by having participants watch either a sad or neutral film and examined the effect this had on chocolate consumption. Participants who watched the sad film experienced greater negative affect and consumed significantly more chocolate than participants who watched a neutral film (Chua et al., 2004).

Finally, another factor that could explain the link between the psychosocial experience of overweight and eating behaviour is stereotype consistent behaviour. There is some evidence that identifying as a member of a stigmatised group can lead people to act in a way that is consistent with the stereotypes held about that group (Ku et al., 2010). For example, when asked to take on the perspective of an elderly individual people walked more slowly (Ku et al., 2010). As a common stereotype about individuals with obesity is that they overeat (Brochu & Esses, 2011) it is possible that implicitly or explicitly self-identifying as being overweight may result in individuals overeating because of stereotype consistent behaviour.

There are also individual differences which could affect the relationship between the psychosocial experience of feeling overweight and eating behavior. There are greater pressures to be thin among women than men (Spitzer et al., 1999) and women with overweight and obesity face greater stigmatization than men with overweight and obesity (Puhl et al., 2008; Roehling & Pichler, 2017). One study examined the differential effects of gender on weight related social identity threat (Blodorn, Major, Hunger, & Miller, 2016). Participants with overweight or obesity were asked to record either an audiotaped (weight not seen) or a videotaped (weight seen) dating video. Women who believed their weight would be seen were more likely to experience higher rejection expectations, anxiety and self-consciousness and lower self-esteem than women who believed their weight would not be seen. However, in men, rejection expectations, anxiety, self-esteem and self-consciousness did not differ between conditions when weight was seen or unseen (Blodorn et al., 2016). This suggests that gender could moderate how an individual responds to the experience of feeling overweight. For example women may be more likely to overeat than men in response to feeling overweight, because of increased negative affect, heightened rejection expectations, or concerns over negative appraisal.

Psychological 'trait' factors could also moderate how the experience of feeling overweight affects eating behaviour. Situational cues can activate negative body image schemas, which in turn result in emotion-laden thoughts about appearance and this is particularly likely in individuals with greater body dissatisfaction (Cash, Skinner, Rotter, & Bandura, 2012). As such, an individual with higher trait body dissatisfaction may respond more negatively to a scenario where body weight is salient than those who are less concerned about their appearance. Trait dietary restraint could also moderate the association between feeling overweight and increased snack food consumption as

participants high in dietary restraint are more likely to eat in response to negative affect (Schotte et al., 1990) than individuals low in dietary restraint.

Across two experimental studies we aimed to replicate the effect that experimentally manipulating the experience of feeling overweight has on snack food consumption (Incollingo Rodriguez et al., 2016) and examine the psychological mechanisms explaining why the psychosocial experience of feeling overweight promotes overeating. In Study 1, we experimentally manipulated the experience of feeling overweight by assigning participants to wear either a body suit that made them appear obese, or control clothing. Moreover, to examine the explanation that feeling overweight may affect snack food consumption due to heightened fear of negative appraisal from others (Major & Brien, 2005; Shapiro & Neuberg, 2007) we manipulated whether participants wore the obese body suit in private or public settings before they were provided with snack foods. We hypothesised that participants who wore the obese body suit would eat significantly more than participants who wore the control clothing. We also hypothesised that this effect would be stronger for participants who completed a task in a public setting, as they would experience greater anticipated stigma and more concerns about their appearance than those in the control condition. We also examined whether changes in affect, self-presentation concerns or the extent to which an individual implicitly associated with feeling overweight mediated the effect of the obese body suit on snack food consumption. In Study 2, we examined whether gender moderated the effect of the obese body suit on snack food consumption. We hypothesised that women who wore the obese body suit would eat more than women who wore the control clothing, but that this effect may be smaller in men as women may be more reactive to anticipated weight stigma than men (Blodorn et al., 2016). We also examined whether self-control, body concerns, self-esteem, affect and the extent to which participants felt overweight explained the effect of the obese body suit on snack

food consumption in Study 2. Across both studies we explored whether a number of trait variables moderated the effect of the obese body suit on snack food consumption. Finally, we report a meta-analysis that examines the consistency of the effect of the obese body suit on snack food consumption across all experimental studies we have conducted to date.

4.3 Study 1

Study 1 examined whether the psychosocial experience of feeling overweight affected snack food consumption. One hundred and twenty women wore an obese body suit or control clothing in public or private settings, before participating in a bogus taste test in which their snack food consumption was measured.

4.3.1 Method

Participants

One hundred and twenty three women were recruited, 3 participants withdrew during the study. Participants were recruited predominantly through a research participation system, in which undergraduate first year psychology students participate in experiments in return for course credit. Participants were also recruited through campus advertisements in return for a small monetary reimbursement. The advertisements stated that participants were being invited to take part in a short study examining the effect of physical characteristics on time and taste perception. The eligibility criteria for participation were that participants should be: women aged 18 or over with no history of food allergies or eating disorders. We asked participants to refrain from eating for two hours before the study in an attempt to ensure baseline hunger was balanced across groups. The final sample had an age range of

18-46 years (M = 19.97, SD = 3.77). The sample's mean Body Mass Index (BMI) was 22.40 (SD = 2.90, Range = 16.59 – 30.62), calculated from objectively measured weight/height^2. We aimed to recruit 120 participants so that we would have 30 participants per cell of the experiment and this provided us with sufficient power to detect the previously reported main effect of the obese body suit on snack food consumption (Incollingo Rodriguez et al., 2016) and a medium to large sized interaction between the clothing condition and setting.

Measures

Affect: Affect was measured with 6 questions asking participants to rate how happy, sad, stressed, irritated, relaxed and angry they felt on a 100 point visual analog scale (VAS) with anchors of 'not at all' and 'extremely'. Items relating to negative affect (sad, stressed, irritated and angry) were averaged to provide a negative affect score and positive items were averaged (happy and relaxed) to calculate a positive affect score.

Hunger: Baseline hunger was measured on a 100 point VAS with anchors of 'not at all' and 'extremely'.

Implicit Association Task (IAT): We included an IAT in order to examine whether wearing the obese body suit resulted in participants implicitly viewing themselves as being overweight. The IAT task used in this study was adapted from a previous study (Kawakami, 2014) and included 8 words pertaining to 'self' (e.g. I, myself), 'others' (e.g. them, theirs), 'overweight' (e.g. fat, chubby) and 'not overweight' (e.g. thin, skinny). The

underlying premise of the IAT task is that an individual will be faster at pairing concepts that are conceptually associated than concepts that are unrelated (Greenwald, Nosek & Banaji, 2003). For example, if a person associated the self with being overweight, they would be faster to pair self and overweight words than self and slim words. Participants took part in 2 practice blocks of 8 trials where they simply had to sort 'self' and 'others' or 'overweight' and 'not overweight' words to the left and right. Participants then engaged in a further two practice blocks of 16 trials where 'self' and 'overweight' words were sorted to the left hand side of the screen and 'other' and 'not overweight' words were sorted to the right hand side of the screen. Thereafter participants took part in a 64 trial critical block where the set up was the same. Following the critical block, 'self' and 'not overweight' words were paired on the left hand side of the screen and 'others' and 'overweight' were sorted to the right hand side of the screen. Participants completed two practice blocks of 16 trials before they completed the 64 trial critical block. The order of blocks was counterbalanced across participants. If the participant made a correct response, a blank screen was presented for 400 ms before the next trial. If the participant made an incorrect response, a red X was displayed for 400 ms before another blank screen was presented for 400 ms before the next trial. D scores were computed using the improved algorithm outlined in Greenwald et al (2003). Trials in which participants made errors were eliminated and replaced with the block mean latency plus a penalty of 600 ms.

Self-Presentation Concerns: A self-presentation concerns questionnaire was based on a previous study (Incollingo Rodriguez et al., 2016). Participants were asked to respond to 5 questions which asked about their experience whilst wearing the study clothing (e.g. "I felt like people were making negative judgements about me" and "I felt rejected") on a 5 point

Likert scale with responses from “strongly disagree” to “strongly agree”. As in Incollingo Rodriguez et al. (2016), the items were averaged to produce a single score.

Trait Body Satisfaction: The 7 item body satisfaction scale was used to measure trait body satisfaction (Slade, Dewey, Newton, Brodie, & Kiemle, 1990). Participants were asked to rate how satisfied they were with specific body parts (e.g. arms) on a 7 point Likert scale, ranging from “very dissatisfied” to “very satisfied”.

Trait Dietary Restraint: Dietary restraint was assessed using the English version of the Dutch Eating Behaviour Questionnaire (DEBQ) (Strien, Bergers, & Defares, 1986). The dietary restraint scale consists of ten items (e.g. “Do you try to eat less at mealtimes than you would like to eat?”), which are scored on a five point scale from “never” to “very often”.

Bogus Taste Test: Participants were provided with two bowls containing 151g of chocolate digestive biscuits and 151g of Maryland cookies, along with a taste perception questionnaire. They were told that they could eat as much or as little from the two bowls as they liked but that they would need to try at least a piece of each cookie in order to complete the questionnaire. The taste perception questionnaire asked participants to compare the two cookies on a series of sensory properties (e.g. “which cookie was crunchiest”). This rating task was included to distract participants from the study aims. Participants were left with the food for 10 minutes. The bowls were weighed before and after participants completed the taste perception task and snack food consumption was

recorded. The bogus taste test has been validated as measure of food consumption (Robinson et al., 2017).

Design

Participants completed a laboratory experiment and were randomly assigned to one of four between-subject conditions. The independent variables were study clothing (obese body suit or control clothing) and task setting (public or private). The dependant variables were snack food consumed (grams), negative affect, positive affect, self-presentation concern scores and IAT scores.

Procedure

Upon arrival, the researcher verbally checked with participants that they had no allergies and that they had not eaten for two hours prior to the study. In order to disguise the true research aims, participants were told that the study was concerned with how physical appearance impacted on perception. After giving informed consent, participants completed baseline affect and hunger measures. Participants were randomly allocated (via an online random number generator) to one of four conditions (obese body suit public, obese body suit private, control public, control private). Participants in the obese body suit conditions were asked to wear a body prosthetic designed to make them appear obese with standard clothing over the top. Whereas participants in the control clothing conditions were shown the standard clothing (identical to that worn in the obese body suit condition) and were asked to select a clothing size that would fit best over their own clothes from the range available (UK size 8-18) (see Figure 4.1). Participants changed and were then positioned in front of a full length mirror whilst the obese body suit/clothing was adjusted by the researcher. To further distract participants from the study aims, all participants were then

told about a fictitious condition in which participants were asked to wear facial prosthetics. Because the body suit weighed approximately 1kg, participants were also asked to wear a backpack; in the obese body suit condition this was empty and in the control condition the bag contained a 1kg weight.

Figure 4.1; Clothing women wore in the obese body suit (top) and control (bottom) conditions in Studies 1 and 2.

Participants were told that their first task was to identify pieces of coloured paper hidden in the laboratory or around the building in which the laboratory was based. Participants in the public condition were then given a route to follow which involved walking around a busy university building. The participants in the private condition completed the same task in an empty lab. Participants were then asked to record the number of pieces of paper they noticed and made judgements about how long they felt the task lasted (in order to strengthen the cover story). Participants then completed the affect measures. After this participants completed the bogus taste test. Participants were then asked to complete the IAT before the measures of body dissatisfaction, dietary restraint and self-presentation concerns. Finally, participants were asked to estimate how many people they saw when wearing the study clothing, as a manipulation check of the public vs.

private manipulation. Participants were then asked to guess the aims of the study, they removed the study clothing, their height and weight was measured by the researcher and they were debriefed.

4.3.2 Analysis

We planned a 2x2 between-subjects ANOVA with study clothing (obese body suit, control clothing) and setting (public, private) as the independent variables and snack food consumption (g) as the dependent variable. Two sensitivity analyses were planned where the primary analysis was re-examined when participants who were identified as outliers on snack food consumption or participants who guessed the aims were removed. Outliers were determined using a decision criterion of .003 [determined by $1 - a / (2n)$ (Cousineau, 2011)], resulting in any participants with a z score of =>.2.807 being classed as outliers. In order to determine which participants had guessed the aims, two independent researchers coded participant responses. In order to be excluded participants had to explicitly link the study clothing with how much they ate during the taste test. Cases of disagreement were reconciled by a third researcher.

We also planned a series of secondary analyses to examine whether negative affect, positive affect, self-presentation concerns and the extent to which participants associated with being overweight (measured by the IAT) mediated the effect of clothing condition on snack food consumption. Two 2x2 between-subjects ANOVAs were planned to examine the effect of the clothing and task setting on self-presentation concerns and IAT scores. As negative and positive affect were measured pre and post clothing manipulation, two mixed 2x2x2 ANOVAs were planned with clothing and setting as the between-subjects variables and time point of measurement (pre and post study clothing) as the within subjects factor.

We next planned to conduct correlational (Pearson's r) analysis to examine whether any of our potential mediators were associated with snack food consumption. If they were, we planned to conduct bootstrapped PROCESS mediation analyses (Hayes, 2013) in order to examine whether negative affect, positive affect, self-presentation concerns and/or IAT scores mediated the relationship between wearing the obese body suit and increased snack food consumption.

4.3.3 Results

Table 4.1

Participant characteristics according to condition in Study 1 (M±SD).

	Obese Body Suit (N = 60)		Control Clothing (N = 60)	
	Public (N = 30)	Private (N = 30)	Public (N= 30)	Private (N= 30)
Age (years)	20.73 (5.45)	19.43 (2.46)	19.50 (2.53)	20.20 (3.88)
BMI	23.32 (3.14)	22.44 (2.72)	22.52 (2.67)	21.31 (2.78)
Baseline Negative Affect[1]	11.46 (11.65)	13.98 (13.36)	13.44 (18.34)	13.05(12.61)
Baseline Positive Affect[1]	62.87 (15.57)	56.47 (16.35)	62.50 (19.55)	58.05 (20.08)
Baseline Hunger	46.77 (25.71)	40.17 (25.23)	51.17 (20.85)	43.60 (21.99)

[1]Negative affect, positive affect and hunger were measured on 100 point VAS where 1 represented "not at all" and 100 represented "extremely".

The Effect of the Obese Body Suit and Setting on Snack Food Consumption

There was a significant main effect of study clothing on snack food consumption [F (1, 116) = 4.87, p = .029, η_p^2 = .04], whereby participants ate more when wearing the obese body suit than when wearing the control clothing. Setting did not significantly impact on consumption [F (1, 116) = .54, p = .464, η_p^2 = .01] and the interaction between clothing

and setting was not significant [F (1, 116) = .89, p = .347, η_p^2 = .01]. See Table 4.2 for condition means and standard deviations.

Sensitivity Analyses

Eleven participants guessed the aims of the study (e.g. explicitly linked the study clothing and snack food consumption) as determined by two independent coders. These participants were excluded and the main analysis was repeated. Although participants in the obese body suit condition (N = 53, M = 40.28, SD = 25.63) consumed more than participants in the control condition (N = 56, M = 33.30, SD = 19.82), the main effect of clothing condition was no longer statistically significant [F (1, 105) = 2.45 p = .120, η_p^2 = .02]. The main effects of task setting [F (1, 105) = 0.47, p = .493, η_p^2 < .01] and the interaction between clothing condition and task setting [F (1, 105) = 1.25, p = .266, η_p^2 = .01] were not significant.

One participant was excluded for having a z score > 2.807 in terms of snack food consumption. The main effect of clothing condition was borderline significant [F (1, 115) = 3.89, p = .051, η_p^2 = .03] whereby participants in the obese body suit condition (N = 59, M = 40.80, SD =24.43) consumed more than those in the control condition (N = 60, M = 32.82, SD = 19.42). The main effect of task setting [F (1, 115) = 0.19, p = .667, η_p^2 < .01] and the interaction between clothing condition and task setting [F (1, 115) = .422, p = .517, η_p^2 < .01] were not significant.

Table 4.2

Snack food consumption (g), affect, self-presentation concerns and IAT scores per condition in Study 1. Values are M (±SD).

	Obese Body Suit (N = 60)		Control Clothing (N = 60)	
	Public (N = 30)	Private (N = 30)	Public (N =30)	Private (N = 30)
Snack Food Consumption (grams)	45.79 (29.97)	38.64 (22.64)	32.38 (19.61)	33.26 (19.55)
Negative Affect Change[1]	-5.10 (11.15)	-2.03 (11.15)	1.43 (9.07)	2.94 (8.56)
Positive Affect Change[2]	15.47 (22.14)	9.35 (18.48)	1.18 (15.56)	1.83 (12.39)
Self-Presentation Concerns	3.46 (0.71)	2.85 (0.87)	3.02 (0.77)	2.04 (0.86)
IAT scores[3]	-0.00 (0.48)	0.05 (0.47)	-0.03 (0.45)	-0.03 (0.45)

[1] Change scores show the difference between baseline and post task scores. A negative score is reflective of an increase in negative affect post task.
[2]A positive score is reflective of a decrease in positive affect post task.
[3] A negative score is reflective of participants having lower response latencies pairing 'me' and 'overweight' words than 'me' and 'slim' words.

Change in Negative Affect

In order to examine whether wearing the obese body suit resulted in greater negative affect a 2x2x2 mixed measures ANOVA was conducted; there was a significant interaction between clothing condition and time point [$F (1, 116) = 9.82$, $p = .002$, $\eta_p^2 = .08$], whereby there was no significant difference in negative affect at baseline between the obese body suit ($M = 12.72$, $SD = 12.49$) and control ($M = 13.25$, $SD = 15.60$) conditions [$t (118) = -2.05$, $p = .999$, $d = .03$], but participants who wore the obese body suit ($M = 16.72$, $SD = 11.67$) exhibited significantly greater negative affect than control participants ($M = 11.06$, $SD = 10.69$) post task [$t (118) = 2.56$, $p = .024$, $d = .51$]. The interactions between setting and time point [$F (1, 116) = 1.56$, $p = .214$, $\eta_p^2 = .01$] and time point, setting and clothing condition [$F (1, 116) = 0.18$, $p = .670$, $\eta_p^2 = .01$] were not significant.

Change in Positive Affect

A 2x2x2 mixed measures ANOVA showed that there was a significant interaction between clothing condition and time point [F (1, 116) = 11.62, p = .001, η_p^2 = .09], whereby there was no significant difference in positive affect at baseline between the obese body suit (M = 59.67, SD = 16.15) and control (M = 60.28, SD = 19.78) conditions [t (118) = .19, p = .999, d = .03], but participants who wore the obese body suit (M = 47.26, SD = 18.17) exhibited significantly less positive affect than control participants (M = 58.77, SD = 20.14) post task [t (118) = .38, p = .002, d = .60]. The interactions between setting and time point [F (1, 116) = .73, p = .394, η_p^2 = .01] and time point, setting and clothing condition [F (1, 116) = 1.12, p = .292, η_p^2 = .01] were not significant.

Self-Presentation Concerns

A 2x2 ANOVA showed that there was a significant main effect of clothing on self-presentation concerns [F (1, 118) = 17.95, p <.001, η_p^2 = .13], whereby participants who wore the obese body suit (M = 3.15, SD = .85) reported greater self-presentation concerns than participants who wore the control clothing (M = 2.53, SD = .95). Furthermore there was a significant main effect of setting [F (1, 118) = 29.32, p <.001, η_p^2 = .20], whereby those who completed a task in public (M = 3.24, SD = .77) reported greater self-presentation concerns than those who completed the same task in private (M = 2.44, SD = .95). There was no significant interaction between setting and clothing condition on self-presentation concerns [F (1, 118) = 1.55, p = .215, η_p^2 = .01].

IAT

No participants had more than 10% of errors or latencies below 300 ms so no participants were excluded. A 2x2 ANOVA showed that the main effects of clothing [$F (1, 118) = .39$, $p = .532$, $\eta_p^2 < .01$] and setting [$F (1, 118) = .08$, $p = .780$, $\eta_p^2 < .01$] and the interaction between clothing and setting [$F (1, 118) = .08$, $p = .780$, $\eta_p^2 < .01$] were not significant.

Mediation Analysis

As the clothing condition did not affect the IAT scores, the conditions for examining implicit perception of overweight as a mediator were not met. The clothing condition significantly affected negative affect, positive affect and self-presentation concerns. As such, we examined whether these factors were associated with snack food consumption in order to determine whether the conditions for mediation were met. Neither self-presentation concerns [$r (120) = .04$, $p = .672$], negative affect change (e.g. post task negative affect minus baseline negative affect) [$r (120) = .14$, $p = .143$] or positive affect change [$r (120) = .02$, $p = .872$] were associated with snack food consumption. Thus, the conditions for tests of formal mediation were not met.

4.3.4 Conclusion

Wearing an obese body suit resulted in women consuming significantly more snack food than those who wore the control clothing, and this effect was not moderated by whether the obese body suit was worn in private or public. These findings support those of a previous study (Incollingo Rodriguez et al., 2016) and suggest that the psychosocial experience of feeling overweight can lead young women to increase their snack food consumption.

Whilst wearing the obese body suit resulted in reduced positive affect, greater negative affect and greater self-presentation concerns, these variables did not mediate the relationship between clothing condition and snack food consumption. Furthermore, we expected participants in the obese body suit condition to implicitly associate themselves with being overweight more than those in the control condition, but we did not find evidence in support of this. It is possible that the body suit manipulation was not strong enough to change implicit beliefs about the self, but could have changed explicit perception of weight; a hypothesis we tested in Study 2.

4.4 Study 2

Study 1 focused on an exclusively female sample. As studies have shown that women react more strongly to anticipated weight stigma (Blodorn et al., 2016), Study 2 examined whether gender moderated the effect of the obese body suit on consumption. Furthermore, as the potential mediators examined in Study 1 did not explain the increase in snack food consumption in participants who wore the obese body suit, Study 2 examined some of these mediators in more detail. Affect was measured in Study 1 using a short form measure, so in Study 2 a more comprehensive measure was used (Watson & Clark, 1988). Similarly, given that in Study 1 we found no evidence that the obese body suit resulted in participants implicitly associating themselves as being ‘overweight’, in Study 2 we examined whether the obese body suit resulted in participants explicitly identifying as being overweight.

Other possible mechanisms were also examined. Self-control is a factor that could explain the association between the psychosocial experience of feeling overweight and increased snack food consumption. Study 1 demonstrated that individuals who wore the

obese body suit were more likely to feel rejected, and experiencing rejection can decrease self-control (Baumeister et al., 2005). Previous research suggests that being in a state of weight based social identity threat is cognitively demanding and can lead to decreases in self-control (Major et al., 2012) which could reduce the likelihood of resisting tempting foods. As such, Study 2 examined whether two measures of self-control (inhibitory control and effortful self-control) mediated the relationship between wearing the obese body suit and snack food consumption.

Negative body image, low self-esteem and/or body anxiety could also mediate the relationship between the experience of feeling overweight and eating behavior. A meta-analysis showed that perceived overweight was a better predictor of body dissatisfaction and low self-esteem than actual overweight (Miller & Downey, 1999). In turn, low self-esteem (Ackard et al., 2003; Martyn-Nemeth et al., 2009) appearance related anxiety (Haase & Prapavessis, 2017; Tiggemann & Kuring, 2004) and having higher body satisfaction concerns (Matos, Aranha, Faria, Ferreira, & Teresa, 2002) are associated with maladaptive eating behaviours. Thus, in Study 2 we examined whether state self-esteem or body anxiety mediated the effect of the obese body suit on consumption.

As wearing an obese body suit has been shown to increase feelings of negative affect in previous studies (Incollingo Rodriguez et al., 2016), emotional regulation is a factor that could moderate the relationship between feeling overweight and snack food consumption. Emotional regulation encompasses two trait responses to negative emotion; cognitive reappraisal and expressive suppression. Cognitive reappraisal is largely considered to be an adaptive reaction to negative emotion, whereby the person attempts to reevaluate the way they feel about a situation in order to deal with negative affect (Gross, 2002). Alternatively, expressive suppression involves suppressing emotional responses and is a maladaptive strategy (Gross & John, 2003). Emotional regulation has been shown to

affect the relationship between negative affect and consumption (Evers, Stok, & de Ridder, 2010). Participants instructed to use expressive suppression techniques in response to a manipulation that elicited negative affect ate significantly more food than participants who were instructed to use cognitive reappraisal or given no instructions (Evers et al., 2010). Participants who use cognitive reappraisal techniques may be more equipped to regulate negative affect and be less likely to eat as a result of wearing the obese body suit. Conversely, those who attempt to suppress negative affect may be more inclined to eat more. Thus, as part of Study 2 we measured emotional regulation and examined whether this moderated the effect of clothing condition on snack food consumption.

Finally, given that a minority of participants appeared to be aware of the study aims in Study 1, in Study 2 we attempted to make the cover story more convincing by leading participants to believe that the bogus taste test was randomly allocated from a series of other tasks. We presumed that if participants thought that the eating task was one option in a range of other tasks they would be less likely to become aware of the study aims.

4.4.1 Method

Participants

One hundred and fifty participants (80 women and 70 men) took part in a laboratory study. Participants were recruited as in Study 1 with the same inclusion criteria and were given the same instructions. The sample had an age range of 18 - 30 years (M = 20.13, SD = 2.56) and a mean BMI of 23.32 (SD = 3.37, Range = 16.84 – 34.26) calculated from objectively measured weight/height^2. A power calculation was used to determine sample size in order to be powered to detect medium sized main and interaction effects (based on the effect sizes in Incollingo Rodriguez et al., 2016 and Study 1) at 80% power. We

recruited slightly above the required sample size to account for having to exclude any participants.

Measures

Effortful Self-Control; Participants were asked to clasp a piece of paper in between the clamp of a handgrip and were instructed to hold the handgrip for as long as they could. Participants were timed until their grip loosened enough for the paper to fall. The hand grip task has been used as a measure of effortful self-control as the person completing the task must override their impulse to loosen their grip to reduce the muscular ache experienced when clamping the handgrip shut (Vohs, Baumeister, & Ciarocco, 2005).

Inhibitory Control; Two Stroop tasks were used in this study, both containing the words "blue", "yellow", "red" and "green" each repeated 20 times in coloured ink incongruent to the word written. In the Stroop task, the participant is asked to read the ink colour rather than the word that is written. The semantic meaning of words holds more value than the colour of the words so the participant has to override their instinct to read the word meaning rather than the ink colour. The Stroop task is a widely used measure of inhibitory control (Inzlicht & Gutsell, 2007).

Body Anxiety; The Physical Appearance State Anxiety Scale (PASTAS) (Reed & Thompson, 1991) was used to examine body anxiety. The scale consists of 16 body parts (e.g. thighs) and asks participants to rate how anxious, tense or nervous they feel about that body part right now on a scale of "not at all" to "exceptionally so" on a 5 point Likert scale.

State Self Esteem; The appearance subscale of the State Self Esteem Scale (Heatherton & Polivy, 1991) consists of six questions which examine an individual's physical self-esteem (e.g. "I am pleased with my appearance right now") and is scored on a 5 point Likert scale where 1 represents "not at all" and 5 represents "extremely".

Affect; The Positive and Negative Affect Scale (PANAS) (Watson & Clark, 1988) consists of 10 positively and 10 negatively valanced emotions and participants are asked to indicate the extent to which they feel each emotion on a 5 point Likert scale of "very slightly or not at all" to "extremely".

Emotional Regulation; The Emotional Regulation Questionnaire (Gross & John, 2003) is a 10 item questionnaire which measures ability to suppress emotional responses (expressive suppression) and reappraise situations to think of them in a more positive way (cognitive reappraisal). The questionnaire is scored on a 7 point Likert scale (strongly disagree - strongly agree).

Explicit Perception of Overweight; Participants responded to three questions that asked if they felt larger than usual, heavier than usual and overweight during the study on a 7 point Likert scale (strongly disagree – strongly agree). Participant responses on the three items were averaged.

Trait Dietary Restraint, Body Satisfaction, Self-Presentation Concerns and Taste Test; the same measures were used as in Study 1.

Design

Participants completed a laboratory experiment and were assigned to one of four between-subject conditions. The independent variable was study clothing (obese body suit or control clothing) and the quasi-independent variable was participant gender (male or female). The dependant variables were snack food consumed (grams), negative affect, positive affect, self-presentation concerns, body anxiety, self-esteem, explicit perception of overweight and inhibitory and effortful self-control.

Procedure

Participants gave informed consent before completing baseline measures of trait dietary restraint, body satisfaction, emotional regulation, affect, effortful self-control and inhibitory control. Participants were then asked to wear the clothing as in Study 1 (see Figure 4.1 and 4.2). Participants then selected their first 'random task'. Participants were asked to select a slip of paper from a box containing five slips in order to determine which task they would complete. In reality all of the slips were identical. Participants then completed the same public task as in Study 1. Participants returned to the lab and filled in a short questionnaire asking how many pieces of paper they noticed and how long they thought the task took in order to strengthen the cover story. Participants then completed the measures of affect, self-esteem, body anxiety, effortful self-control and inhibitory control. Participants were next asked to select their second "random task" and all participants selected the taste test. They were left alone for 10 minutes and asked to complete the same taste perception questions as in Study 1. Finally, to further bolster the cover story participants were asked to complete a time perception questionnaire before being asked to guess the aims of the study, completing the measures of self-presentation concern and the

explicit perception of overweight measure. Participants then removed the study clothing. Height and weight were measured and participants were debriefed.

Figure 4.2; Clothing men wore in the obese body suit (top) and control (bottom) conditions in Study 2.

4.4.2 Analysis

A 2x2 between-subjects ANOVA was planned with gender (men and women) and clothing (obese body suit or control) as the IVs and snack food consumption (grams) as the dependent variable. Sensitivity analyses were also planned whereby participants who were outliers (Z score over 2.807 determined in the same way as in Study 1) on snack food consumption and those who guessed the aims (determined by the same process as Study 1) were excluded and the primary analysis was repeated. The same approach was used as in Study 1 for examining possible mediators.

4.4.3 Results

Table 4.3

Participant characteristics in Study 2 (M±SD).

	Obese Body Suit (N= 76)		Control Clothing (N = 74)	
	Men (N = 36)	Women (N = 40)	Men (N = 34)	Women (N = 40)
Age (years)	21.75 (3.07)	19.28 (1.81)	20.21 (2.52)	19.48 (2.09)
BMI	23.48 (3.57)	22.79 (3.58)	24.01 (2.97)	23.12 (3.28)
Negative Affect[1]	14.11 (4.10)	12.08 (1.72)	13.53 (3.93)	13.48 (4.08)
Positive Affect[1]	28.06 (8.69)	27.63 (6.68)	26.59 (7.91)	27.10 (7.30)
Hunger[2]	2.86 (1.22)	2.63 (1.41)	3.32 (1.20)	2.83 (1.11)

[1]Negative affect and positive affect are the sums of 10 negatively and 10 positively valenced emotions measured on a 7 point Likert scale where participants indicated the extent that they currently felt the target emotion (1 represented "very slightly or not at all" and 7 represented "extremely").
[2] Hunger was measured on a 7 point Likert scale where 1 represented "very slightly or not at all" and 7 represented "extremely".

The Effect of Clothing and Gender on Snack Food Consumption

There was a significant main effect of gender on snack food consumption [$F (1, 146) = 12.61$, $p = .001$, $\eta_p^2 = .08$], whereby men ate more than women. The main effect of clothing was not significant [$F (1, 146) = 0.41$, $p = .522$, $\eta_p^2 < .01$], but there was a significant interaction between gender and clothing [$F (1, 146) = 4.05$, $p = .046$, $\eta_p^2 = .03$]. Bonferroni corrected t-tests showed that women who wore the obese body suit consumed significantly more than women in the control clothing [$t (78) = 2.46$, $p = .032$, $d = .55$]. However, there was not a significant difference between men in the obese body suit and control condition for snack food consumption [$t (68) = 0.78$, $p = .872$, $d = .19$]. See Table 4.4 for condition means.

Table 4.4

Snack food consumption (g) and mediators per condition in Study 2 (M±SD).

	Obese Body Suit (N = 76)		Control Clothing (N = 74)	
	Men (N = 36)	Women (N = 40)	Men (N =34)	Women (N = 40)
Snack Food Consumption (grams)	48.72 (30.12)	42.30 (24.62)	54.44 (30.90)	31.23 (14.34)
Body Anxiety	34.78 (9.04)	39.78 (9.47)	23.38 (6.87)	31.40 (8.46)
Self-Esteem	13.00 (5.32)	12.45 (5.25)	19.38 (3.21)	15.80 (3.73)
Self-Presentation Concerns	3.49 (0.73)	3.50 (0.87)	2.68 (0.92)	3.07 (0.92)
Perception of Overweight	5.28 (1.22)	5.76 (1.38)	3.12 (1.29)	4.07 (1.55)
Inhibitory Self-Control[1]	8.00 (6.90)	6.33 (6.92)	6.82 (4.35)	7.55 (4.75)
Effortful Self-Control[2]	4.33 (30.65)	9.83 (23.07)	-6.56 (27.03)	0.85 (22.49)
Negative Affect Change[3]	-0.61 (3.06)	-1.78 (4.54)	0.32 (4.58)	0.80 (4.40)
Positive Affect Change[4]	0.58 (4.15)	1.75 (4.73)	0.62 (6.64)	.00 (5.29)

[1]A positive score is reflective of an improvement in performance (i.e. participants completed the Stroop more quickly post task).
[2]A positive score is reflective of a decrease in performance post task (i.e. participants held the hand grip for a shorter time).
[3]Change scores show the difference between baseline and post task scores. A negative score is reflective of an increase in negative affect post task
[4]A positive score is reflective of a decrease in positive affect post task.

Sensitivity Analyses

As in the main analysis, when the 4 participants were excluded for guessing the aims there was no main effect of clothing condition on snack food consumption [$F (1, 142) = .243$ $p = .623$ $\eta_p^2 < .01$]. There was a significant main effect of gender on snack food consumption [$F (1, 142) = 12.95$, $p < .001$, $\eta_p^2 = .08$] whereby men (N = 66, M = 51.30, SD = 28.56) consumed more overall than women (N = 80, M = 36.76, SD =20.78). The interaction between clothing condition and gender was also significant [$F (1, 142) = 5.05$, $p = .026$, $\eta_p^2 = .03$]. Women in the obese body suit condition (N = 40, M = 42.30, SD = 24.62)

consumed significantly more than women in the control condition (N = 40, M = 31.23, SD = 14.34) [t (78) = 2.46, p = .032, d = .55]. However, there was no significant difference in snack food consumption between men in the obese body suit (N = 33, M = 47.76, SD = 25.54) and control (N = 33, M = 54.85, SD = 31.28) conditions [t (64) = -1.01, p = .624, d = .25].

As in the main analysis, when the 3 outliers (z score > 2.807) were removed the main effect of clothing condition was not significant [F (1, 143) = .20, p = .652, η_p^2 = .001]. The main effect of gender was significant [F (1, 143) = 12.53, p = .001, η_p^2 = .08] whereby men (N = 68, M = 48.82, SD = 26.42) consumed more than women (N = 79, M = 35.72, SD = 18.70). The interaction between clothing condition and gender was also significant [F (1, 143) = 4.02, p = .047, η_p^2 = .03], women in the obese body suit condition (N = 39, M = 40.33, SD = 21.53) consumed more than women in the control condition (N = 40, 31.23, SD = 14.34) [t (77) = 2.22, p = .058, d = .50], although this difference was not statistically significant. There was no difference in snack food consumption [t (66) = .90, p = .746, d = .22] between men in the obese body suit (N = 35, M = 46.03, SD = 25.79) and control conditions (N = 33, M = 51.79, SD = 27.16).

Body Anxiety

A 2x2 ANOVA showed that there was a significant main effect of gender on body anxiety scores [F (1, 146) = 21.54, p < .001, η_p^2 = .13], whereby women (M = 35.59, SD = 9.87) had higher body anxiety than men (M = 29.24, SD = 9.85). Clothing also had a significant effect on body anxiety [F (1, 146) = 49.70, p < .001, η_p^2 = .25], whereby participants who wore the obese body suit (M = 37.41, SD = 9.55) felt more anxious about their bodies than

controls (M = 27.72, SD = 8.71). There was no significant interaction between clothing condition and gender [F (1, 146) = 1.16, p = .283, η_p^2 = .01].

Self-Esteem

A 2x2 ANOVA showed that there was also a significant main effect of gender on self-esteem scores [F (1, 146) = 7.89, p = .006, η_p^2 = .05], whereby women (M = 14.13, SD = 4.83) had lower self-esteem than men (M = 16.10, SD = 5.44). Clothing also had a significant effect on self-esteem [F (1, 146) = 43.75, p < .001, η_p^2 = .23], whereby participants who wore the obese body suit (M = 12.71, SD = 5.26) reported having lower self-esteem than those who wore the control clothing (M = 17.45, SD = 3.91). The interaction was also significant [F (1, 146) = 4.25, p = .041, η_p^2 = .03], self-esteem was lower in the obese body suit condition (Men M = 13.00, SD = 5.32, Women M = 12.45, SD = 5.25) than in the control clothing condition (Men M = 19.38, SD = 3.21, Women M = 15.80, SD = 3.73) for both men [t (68) = -6.04, p < .001, d = 1.45] and women [t (78) = -3.29, p = .004, d = .74], although this effect was larger in men.

Self-Presentation Concerns

A 2x2 ANOVA showed that clothing had a significant effect on self-presentation concerns [F (1, 146) = 19.50, p < .001, η_p^2 = .12], whereby participants who wore the obese body suit (M = 3.50, SD = .80) felt more self-presentation concern than controls (M = 2.89, SD = .93). The main effect of gender [F (1, 146) = 1.99, p = .160, η_p^2 = .01] and the interaction were not significant [F (1, 146) = 1.88, p = .172, η_p^2 = .01].

Explicit Perception of Overweight

There was a significant main effect of gender on perceived overweight [F (1, 146) = 10.12, p = .002, η_p^2 = .07], with women (M = 4.91, SD = 1.69) feeling more overweight than men (M = 4.23, SD = 1.65). Clothing also had a significant effect on explicit perception of overweight [F (1, 146) = 73.48, p < .001, η_p^2 = .34], whereby participants who wore the obese body suit (M = 5.53, SD = 1.32) felt more overweight than controls (M = 3.63, SD = 1.50). The interaction was not significant [F (1, 146) = 1.09, p = .299, η_p^2 = .01].

Inhibitory Self-Control

A 2x2x2 mixed measures ANOVA showed that the interactions between time point and gender [F (1, 146) = .24, p = .623, η_p^2 < .01], time point and clothing condition [F (1, 146) = .00, p = .980, η_p^2 < .01] and time point, clothing condition and gender [F (1, 146) = 1.56, p = .214, η_p^2 = .01] were not significant.

Effortful Self-Control

A 2x2x2 mixed measures ANOVA showed that the interaction between time point and gender [F (1, 146) = 2.33, p = .129, η_p^2 = .02] and time point, gender and clothing [F (1, 146) = .05, p = .821, η_p^2 < .01] were not significant. The interaction between time point and condition was significant [F (1, 146) = 5.52, p = .020, η_p^2 = .04], whereby participants in the obese body suit condition performed significantly worse post clothing (M = 49.03, SD = 36.34) than at baseline (M = 56.25, SD = 38.70) [t (75) = 2.34, p = .044, d = .19]. There was however, no difference in effortful self-control between baseline (M = 52.77,

SD = 35.75) and post task (M = 55.32, SD = 37.83) in the control condition [t (73) = .89, p = .756, d = .07].

Negative Affect

A 2x2x2 ANOVA showed that the interactions between time point and gender [F (1, 146) = .25, p = .618, $\eta_p^2 < .01$] and time point, gender and clothing condition [F (1, 146) = 1.42, p = .236, $\eta_p^2 = .01$] were not significant. There was a significant interaction between clothing condition and time point [F (1, 146) = 6.49, p = .012, $\eta_p^2 = .04$], whereby participants who wore the obese body suit reported significantly higher negative affect post task (M = 14.26, SD = 4.68) than at baseline (M =13.04, SD = 3.23) [t (75) = 2.71, p = .016]. There was no significant difference between baseline (M = 13.50, SD = 3.99) and post task (M = 12.92, SD = 4.61) negative affect in the control condition [t (73) = 1.12, p =.266].

Positive Affect

A 2x2x2 ANOVA showed that the interactions between time point and gender [F (1, 146) = .10, p = .750, $\eta_p^2 < .01$], time point and clothing condition [F (1, 146) = 1.00, p = .320, $\eta_p^2 < .01$] and time point, clothing condition and gender [F (1, 146) = 1.08, p = .301, $\eta_p^2 < .01$] were not significant.

Mediation Analyses

As the clothing condition did not affect inhibitory control or positive affect, the conditions for mediation analysis for these factors were not met. None of the proposed mediators that

were affected by the clothing condition (body anxiety, self-esteem, self-presentation concerns, explicit perception of overweight, effortful self-control and negative affect) were associated with snack food consumption, so formal mediation analysis was not appropriate (Table 4.5).

Table 4.5

Correlations between snack food consumption and potential mediators for men and women in Study 2 (N = 150).

Proposed mediator	r(df) and p statistics for correlation with snack food consumption
Body Anxiety	r (150) = .04, p =.635
Self Esteem	r (150) = -.11, p = .200
Self-Presentation Concerns	r (150) = -.03, p = .717
Explicit Perception of Overweight	r (150) = .08, p = .360
Effortful Self-Control Change	r (150) = .05, p = .543
Negative Affect Change	r (150) = -.01, p = .873

4.4.4 Conclusion

The effect of the obese body suit on snack food consumption was moderated by gender, whereby women who wore the obese body suit ate more than women who wore the control clothing, but there was no difference in snack food consumption between the obese body suit and control condition for men. Wearing the obese body suit resulted in participants reporting feeling overweight, increased negative affect, heightened self-presentation concerns and body anxiety, as well as lower self-esteem and decreased effortful self-control. However, none of these factors mediated the effect of the obese body suit on increased consumption in women. The obese body suit did not affect inhibitory control or positive affect.

4.5 Additional Analyses

Moderation Analyses

In order to examine whether any of the measured trait variables moderated the effect of the obese body suit on snack food consumption PROCESS moderation analyses (Hayes, 2013) were conducted. We examined the three way interaction between clothing, gender and body satisfaction, clothing, gender and dietary restraint, clothing, gender and cognitive reappraisal and clothing, gender and expressive suppression. As dietary restraint and body satisfaction were measured in both studies the data files were merged and the PROCESS moderation analysis was conducted on both datasets together for body satisfaction and dietary restraint. For cognitive reappraisal and expressive suppression the moderation models were conducted on the Study 2 data only, as emotional regulation was not examined in Study 1. PROCESS moderation analysis was used whereby clothing was the X variable, snack food consumption was Y, the moderator (either body satisfaction, dietary restraint, cognitive reappraisal or expressive suppression) was M and gender was W. PROCESS computes direct effects of X, M and W on Y, as well as interaction terms for the effects of XxM, XxW, MxW and XxMxW on Y.

Results

Dietary Restraint

The overall model with dietary restraint as the moderator was significant [$F (7, 262) = 4.13$, $p < .001$, $R^2 = .11$]. However, there was no evidence that dietary restraint moderated the effect of the obese body suit on snack food consumption (See Table 4.6 for Statistics for individual predictors and interaction terms).

Body Satisfaction

The overall model with body satisfaction as the moderator was significant [F (7, 262) = 4.11, $p < .001$, $R^2 = .11$], but there was no evidence body satisfaction moderated the effect of the obese body suit on snack food consumption (Table 4.6).

Cognitive Reappraisal

The overall model with cognitive reappraisal as the moderator was significant [F (7, 142) = 3.75, $p < .001$, $R^2 = .13$], but there was no evidence that cognitive reappraisal moderated the effect of the obese body suit on snack food consumption (Table 4.6).

Expressive Suppression

The overall model with expressive suppression as the moderator was significant [F (7, 142) = 4.24, $p < .001$, $R^2 = .14$], but again there was no evidence that expressive suppression moderated the effect of the obese body suit on snack food consumption (Table 4.6).

Table 4.6.

Statistics for the direct effects and interactions of body satisfaction, dietary restraint and expressive suppression in Studies 1 and 2.

	B(SE)[1]	t	P	LLCI, ULCI[4]
Trait Body Satisfaction (TBS)[2] N = 270				
TBS (M)	-.40 (.25)	-1.57	.117	-.89, .10
Clothing (X)	-6.29 (3.19)	-1.97	.050	-12.58, .01
Gender (W)	-15.83 (4.54)	-3.49	<.001	-24.77, -6.88
Clothing x TBS	.11 (.50)	.21	.831	-.88, 1.10
Clothing x Gender	-15.68 (9.08)	-1.73	.085	-33.55, 2.19
TBS x Gender	.05(.66)	.08	.937	-1.26, 1.36
Clothing x TBS x Gender	.13 (1.33)	.10	.923	-2.49, 2.75
Dietary Restraint (DR)[2, 3] N = 270				
DR (M)	-.49(.22)	-.23	.820	-4.70, 3.73
Clothing (X)	-4.05(3.40)	-1.19	.235	-10.74, 2.64
Gender (W)	-13.47(5.00)	-2.69	.008*	-23.32, -3.62
Clothing x DR	2.54(4.27)	.59	.553	-5.87, 10.96
Clothing x Gender	-21.93(9.99)	-2.19	.030*	-41.61, -2.24
DR x Gender	-2.06(6.13)	-.34	.737	-14.14, 10.01
Clothing x DR x Gender	-19.38(12.26)	-1.58	.115	-43.52, 4.77
Cognitive Reappraisal (CR) N = 150				
CR (M)	.42(.44)	.94	.348	-.46, 1.29
Clothing (X)	-3.87(4.21)	-.92	.359	-12.19, 4.44
Gender (W)	-14.40(4.34)	-3.32	.001*	-22.97, -5.83
Clothing x CR	1.37(.88)	1.56	.122	-.37, 3.12
Clothing x Gender	-16.49(8.66)	-1.90	.059	-.33.61, .63
CR x Gender	-.38(.89)	-.43	.671	-2.15, 1.39
Clothing x CR x Gender	-1.17(1.79)	-.65	.517	-4.71, 2.38
Expressive Suppression (ES) N = 150				
ES (M)	-.92(.57)	-1.61	.109	-2.04, .21
Clothing (X)	-3.03(4.42)	-.68	.495	-11.76, 5.71
Gender (W)	-16.97(4.59)	-3.70	<.001*	-26.03, -7.90
Clothing x ES	1.39(1.14)	1.21	.227	-.87, 3.65
Clothing x Gender	-12.96(9.16)	-1.41	.159	-31.08, 5.15
ES x Gender	-.49(1.19)	-.41	.680	-2.84, 1.86
Clothing x ES x Gender	.97(2.40)	.40	.688	-3.77, 5.70

[1] B = unstandardized regression coefficient (SE = standard error)
[2] Moderation models for TBS and DR are based on the pooled data from Studies 1 and 2.
[3] Due to an error, we do not have data for question 10 of the DR scale in Study 1. As such, rather than total scores, average DR scores were combined for Studies 1 and 2.
[4] CIs are 95% bias corrected confidence intervals, LLCI and ULCI represent upper and lower levels of the CI.

Meta-Analysis

As the effect of the obese body suit on snack food consumption has now been examined in multiple studies, we conducted a meta-analysis in order to estimate the overall effect of the obese body suit on consumption across all available studies. Four studies we are aware of have examined the effect of the obese body suit on snack food consumption in women; (Incollingo Rodriguez et al., 2016, studies 1 and 2 of this paper and a fourth study - Oldham, Tomiyama & Robinson, 2017). In this fourth study we examined the effect of the obese body suit on alcohol and food consumption but there was no significant effect of the obese body suit on food consumption. This may have been due to the presence of alcohol in the taste test affecting appetite (Oldham et al., 2017).

Two of these studies have examined the effects of the obese body suit in men and women (Incollingo Rodriguez et al., 2016 and Study 2 of this paper). As we found that wearing the obese body suit resulted in women eating more but did not affect consumption in men we examined the effect of the obese body suit on consumption in men and women separately as well as the overall combined effect. Standardized mean differences (SMD) of snack food consumption in the obese body suit vs. control conditions were calculated for each study. The individual SMDs were synthesized via a fixed effects meta-analysis using RevMan version 5.1. We used a fixed effects model as the protocol and samples in each of the four studies were similar. Incollingo Rodriguez et al. (2016) examined the effect of the obese body suit on consumption of two food types (crisps and chocolate). As such, we combined the two food types and examined overall calories consumed.

Figure 4.3 depicts a forest plot from studies that examined the effect of the obese body suit on snack food consumption. Four studies contributed 6 comparisons (2 with men, 4 with women) into the analyses. Overall, a small to medium sized effect was observed whereby participants ate more in the obese body suit conditions than in the control

conditions (fixed effects SMD: 0.27; 95% CI: 0.08, 0.45; Z = 2.87; p = .004; I^2 = 55%). Formal sub group analyses are inappropriate as the number of studies that have examined the effect of the obese body suit on snack food consumption in men is limited. However, a tentative examination of the sub group differences suggests that while the suit is associated with an increase in snack food consumption in women (fixed effects SMD: 0.34; 95% CI: 0.13, 0.54; Z = 3.22; p = .001; I^2 = 55%), this effect was not present in men (fixed effects SMD: -0.01; 95% CI: -0.42, 0.40; Z = 0.04; p = .97; I^2 = 55%).

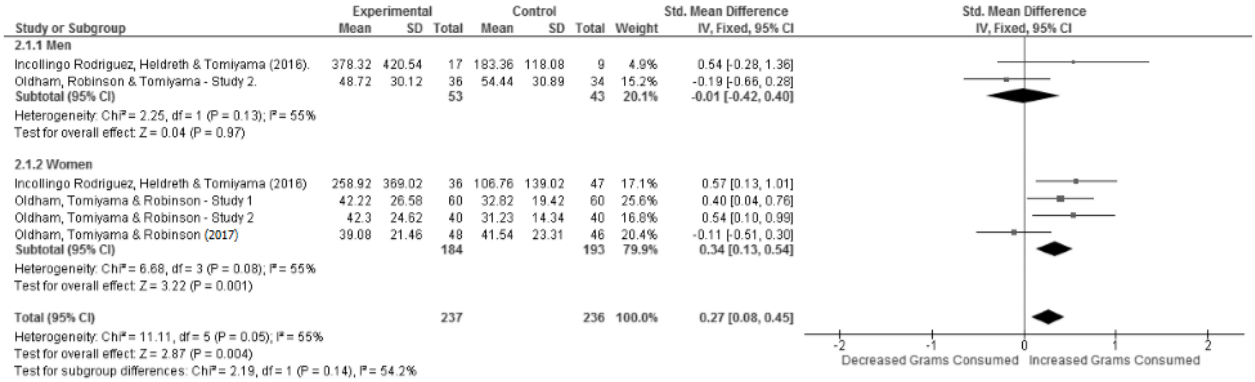

Figure 4.3; Forest plot of fixed effects meta-analysis examining the effect of the obese body suit on snack food consumption in men and women.

4.6 General Discussion

Across two studies we examined the effect of wearing an obese body suit on snack food consumption. Study 1 showed that experimentally manipulating the feeling of being overweight with an obese body suit resulted in women consuming more snack food than those who were not made to feel overweight. These findings are in line with those of a previous study which demonstrated that wearing an obese body suit led to increased consumption of snack foods (Incollingo Rodriguez et al., 2016). In Study 2 we examined whether the same effect was observed in men. The results of Study 2 indicated that

wearing the obese body suit was associated with an increase in snack food consumption among women, but not men. Across both studies we examined potential psychological mediators of the effect of the obese body suit on snack food consumption, but did not find evidence of mediation in either Study 1 or Study 2. Finally, we conducted a meta-analysis which synthesised data from the four studies we are aware of that have examined the effect of wearing an obese body suit on snack food consumption. The meta-analysis demonstrated a small to moderate effect of the obese body suit on snack food consumption.

In Study 1 we examined whether fear of negative evaluation from others may in part explain the effect of the obese body suit on snack food consumption. We attempted to test this by manipulating whether participants were exposed to other people (public settings) or not (private settings) when wearing the study clothing. However, wearing the obese body suit resulted in increased snack food consumption and this effect did not appear to be significantly moderated by whether the obese body suit was worn in public or private settings. As obesity is such a widely stigmatised condition, internalised weight stigma could have affected eating behaviour in the absence of others (Heuer et al., 2011; Major & Brien, 2005). Alternatively, irrespective of wearing the suit in social isolation (with the exception of a single present experimenter), participants in the private conditions may have still feared potential negative evaluation from others.

Study 2 showed that the effect of the obese body suit on snack food consumption was moderated by gender, whereby women who wore the obese body suit ate more than women who wore the control clothing, but there was no effect of clothing on snack food consumption in men. There is more societal emphasis on the thin ideal for women (Spitzer et al., 1999) and the size of bodies which are considered normal for women is considerably smaller than the size of bodies considered normal (Oldham & Robinson, under review) or acceptable (Cachelin, Rebeck, Chung, & Pelayo, 2002) for men. Women report

experiencing more weight stigma than men in some studies (Puhl et al., 2008) and previous studies have shown that women are more reactive to anticipated weight stigma then men (Blodorn et al., 2016). These studies suggest that women may have greater concerns about their weight than men and this may explain the gender effect we observed in Study 2.

Across both studies we examined a number of possible mechanisms that could explain why wearing the obese body suit increased snack food consumption. We hypothesised that the obese body suit may cause increased snack food consumption by increasing negative affect, heightening self-presentation concerns, increasing anxiety around physical appearance, reducing self-esteem and/or impairing self-control. However, none of these potential mediators were associated with snack food consumption in either study. One possible explanation of our failure to identify the psychological variables mediating the effect of the obese body suit on snack food consumption is that although where possible we used validated measures, the measures used to assess the proposed mediators did not do so sensitively. Alternatively, other processes may be responsible. For example, one factor that may be important is stress. Although similar to negative affect, stress is a theoretically distinct construct (Lazarus & Folkman 1984) that could be relevant in this context. A previous study showed that stress induced overeating mediated the effect of self-perceived overweight on weight gain (Robinson et al., 2015). Because of the stigma associated with obesity, wearing an obese body suit is likely to be stressful and stress has been consistently linked with the drive to eat (Groesz et al., 2012) and increased food consumption (Epel, Lapidus, & Mcewen, 2001). Future studies could examine the mediating role of stress and the extent to which individual differences in stress induced overeating may be important in explaining the effect that feeling overweight has on snack food consumption.

We also examined moderation of the effect the obese body suit had on snack food consumption by individual differences measured across both studies. However, these analyses were limited in sample size and should be considered exploratory in nature. Neither dietary restraint, body dissatisfaction nor emotional regulation moderated the effect of the experience of feeling overweight on snack food consumption. One factor which was not measured in this study and which may moderate the effect of the obese body suit on snack food consumption is stigma consciousness (Major & O'Brien, 2005). Individuals higher in stigma consciousness are more likely to be vigilant to potential stigma or threats (Pinel, 1999). As such, individuals higher in stigma consciousness may experience greater threat or anticipated stigma when wearing the obese body suit, which could lead them to eat more in response to heightened stereotype threat. Eating to cope is another factor that could moderate the effect of the obese body suit on snack food consumption. Eating to cope is a construct which quantifies the extent to which people are motivated to eat in response to negative affect (Lokken & Boggiano, 2013) and is associated with BMI (Boggiano et al., 2014). Furthermore, increases in eating to cope motivations are associated with weight gain over time amongst individuals with overweight (Boggiano et al., 2015). Based on the effect of the obese body suit on negative affect in the present study and a previous study (Incollingo Rodriguez et al., 2016), it is possible that women who overeat in response to negative affect would eat more in response to the psychosocial experience of feeling overweight than those less motivated to eat in response to negative affect.

Limitations

The samples in the present studies were young women and men who were predominantly university students. Young women in particular report high levels of weight and shape

concern (Grossbard, Lee, Neighbors, & Larimer, 2009; Lowery et al., 2005). Furthermore, age is associated with the amount of importance placed on appearance, whereby appearance is perceived as being less important as one grows older (Tiggemann, 2004). Thus, the same effects observed in the present studies may not be observed in older adults and replication in more diverse samples would now be of interest. Furthermore, the current studies also do not provide any evidence for the longevity of the effect that feeling overweight has on snack food consumption, as we examined consumption in a single session. Finally, although we selected sample sizes to ensure we were sufficiently powered to detect effects in our main analyses, some of the secondary moderation analyses are unlikely to be adequately powered.

4.7 Conclusion

The psychosocial experience of feeling overweight leads to increased snack food consumption in women, but not men. However, the psychological mechanisms explaining this effect are unclear.

Chapter 5: General Discussion

5.1 Introduction

This thesis had two overarching aims; the first aim was to examine visual underestimation of overweight and obesity and to test the theory that visual underestimation of overweight and obesity is explained by the increase in the prevalence of overweight and obesity having created an upwards shift in the range of bodies that are visually perceived as being normal in size. The second aim was to examine whether the psychosocial experience of feeling overweight affects snack food consumption and to evaluate the role of potential mechanisms in explaining why feeling overweight can affect eating behaviour. In this discussion I will firstly provide an overview of the main findings from each chapter. I will then go on to consider the theoretical implications and applied relevance of this work. Finally I will outline limitations and future directions for research before offering a final conclusion.

5.2 Overview of Studies

The main aims of Chapter 2 were to examine whether a large sample of the general public would visually underestimate the weight status of men with normal weight, overweight and obesity and to examine whether exposure to heavier bodies increased the likelihood of underestimation of overweight. It was hypothesised that the weight status of men with overweight and obesity would be visually underestimated and that exposure to heavier bodies would result in greater underestimation of overweight. In line with this hypothesis, Study 1 demonstrated that the weight status of men with overweight and obese BMIs was frequently underestimated, whereby men were judged as being a healthier weight status than they objectively were.

In Study 2 I examined whether having heavier male friends was associated with the tendency to visually underestimate overweight and obesity. Individuals with heavier friends would be more frequently exposed to heavier body weights than those with slimmer friends. If exposure to heavier body weights is partially responsible for visual underestimation of weight status, then individuals with heavier male friends should be particularly likely to underestimate the weight status of other men. As such, I predicted that having heavier friends would be associated with more frequent underestimation of overweight. In support of this, Study 2 showed that individuals with heavier peers were more likely to underestimate overweight and obesity visually.

Finally in Study 3, I experimentally examined whether exposure to men with obesity resulted in a greater tendency to visually underestimate overweight relative to those exposed to men with normal weight BMIs or control images. Exposure to men with normal weight, relative to control images and men with obesity, reduced the likelihood that participants underestimated the weight status of an overweight male. There was no difference in underestimation of overweight when participants were exposed to control images and men with obesity. As the sample was American and the prevalence of obesity in America is high (Ogden et al., 2014), it is plausible that this result is explained by the men with obesity that participants were exposed to being reflective of the body weights that participants would normally encounter. Collectively, the three studies from Chapter 2 show that the weight status of men with overweight and obesity is systematically underestimated and that this may in part be due to exposure to heavier bodies.

The first aim of Chapter 3 was to examine whether the weight status of both men and women with normal weight, overweight and obesity would be visually underestimated. Secondly, Chapter 3 aimed to test the novel hypothesis that visual underestimation of overweight and obesity could be in part caused by increased exposure to heavier bodies

creating an upwards shift in the body sizes that are visually perceived as being normal. It was hypothesised that both male and female overweight and obesity would be visually under-detected, but that underestimation of male overweight and obesity would be particularly prevalent. Furthermore, it was hypothesised that visual body size norms would be associated with underestimation of overweight and obesity and would mediate the association between exposure to heavier bodies and underestimation. In Study 1, I found that the weight status of men and women with overweight and obesity was frequently visually underestimated. There were gender differences in underestimation whereby male overweight and obesity was more likely to be underestimated.

In Study 2, I comprehensively examined whether body size norms were associated with underestimation of male and female overweight, with the theory being that estimation of weight status is influenced by whether a body is perceived as being normal. Based on previous research two types of body size norm may be of importance; what a person sees as being the 'average' sized body (Panis et al., 2010) or the range of body sizes that a person sees as being 'normal' (Tovée et al., 2012). As such, in Study 2 I measured both an average body size norm and the range of bodies which were considered normal in order to examine which of these factors was associated with visual underestimation of male and female overweight. I found that only the largest body which was categorised as appearing visually normal was consistently associated with underestimation of both male and female overweight. Furthermore there was a discrepancy in the largest bodies that were visually perceived as being normal for men vs. women and this was associated with the tendency for male overweight and obesity to be more frequently underestimated than female overweight and obesity. Specifically, the largest body size that was considered normal for men was significantly larger than the largest body size perceived as being normal for

women, which in part explained why the weight status of men with overweight was more likely to be visually underestimated than the weight status of women with overweight.

Finally, in Study 3 I examined whether change in body size norms explained why exposure to heavier bodies leads to greater underestimation of overweight. Participants were exposed to images of either normal weight or obese men or women. They then completed the same measures of body size norms as in Study 2 before they were asked to judge the weight status of a man or woman with overweight. Body size norms significantly mediated the relationship between exposure to heavier bodies and underestimation of overweight. The heaviest body which was considered to be within a normal range consistently mediated the effect of exposure to heavier body sizes on underestimation of male and female overweight, whereas the body which was considered to represent the average only mediated the effect of exposure to heavier bodyweights on underestimation of male overweight. Overall these three studies provide support for a norm based account of underestimation of overweight; exposure to heavier bodies as an outcome of increasing levels of obesity mean that larger bodies are perceived as falling within a normal range of body sizes and this results in overweight and obesity being visually under-detected.

To address the second aim of this thesis, in Chapter 4 I examined the effect that the psychosocial experience of feeling overweight has on eating behaviour and evaluated the potential mechanisms underlying this effect. In Study 1, I examined whether wearing an obese body suit in public or private settings resulted in increased snack food consumption in women. I also examined several mechanisms which may explain the effect of the obese body suit on snack food consumption. Specifically, I examined whether changes in affect, concerns over negative evaluation from others or the extent to which individuals implicitly associated as being overweight mediated the effect of the obese body suit on snack food consumption. Wearing an obese body suit resulted in increased snack food consumption in

women, regardless of whether they were exposed to other people when wearing the obese body suit. There was no evidence for any of the potential mechanisms examined. I had anticipated that participants who wore the body suit would be more likely to implicitly associate themselves with being overweight than those in the control conditions but there was no evidence to support this. Although wearing an obese body suit resulted in greater negative affect, lower positive affect and fear of negative appraisal, these variables did not mediate the relationship between wearing an obese body suit and increased snack food consumption.

In Study 2 of Chapter 4, I examined whether gender moderated the effect of wearing an obese body suit on snack food consumption. Wearing an obese body suit led to increased snack food consumption in women but not men. The secondary aim of Study 2 was to identify mechanisms which could explain the effect of the obese body suit on consumption. I measured affect, effortful self-control, inhibitory control, self-esteem, body anxiety and explicit perception of overweight alongside fear of negative appraisal as measured in Study 1. None of these factors were associated with consumption, nor did they appear to explain the effect of the obese body suit on snack food consumption. Furthermore, I found no support for possible individual differences that could moderate the effect of the obese body suit on consumption. Neither dietary restraint, body satisfaction nor emotional regulation moderated the effect of the obese body suit on snack food consumption. Alongside Studies 1 and 2 of Chapter 4, I conducted a meta-analysis which synthesises the data from 4 studies that have examined the effect of an obese body suit on snack food consumption. The meta-analysis demonstrates a small to moderate effect of the obese body suit on snack food consumption. These studies suggest that the psychosocial experience of overweight could result in increased snack food consumption in women, although the mechanism for this effect is still unclear.

5.3 Theoretical Implications

The findings of this thesis have several theoretical implications. Although previous research demonstrates a high level of personal underestimation of weight status (Andrade, Raffaelli, Teran-Garcia, Jerman, & Garcia, 2012; Duncan et al., 2011; Nyholm et al., 2007; Robinson & Oldham, 2016; Spencer, Appleby, Davey, & Key, 2002), parental underestimation of child overweight and obesity (Lundahl et al., 2014; Parry et al., 2008; West et al., 2008) and underestimation of overweight and obesity in clinical settings (Bardia et al., 2007; Bramlage et al., 2004), the reasons for underestimation have been unclear. Due to a high level of weight stigma in the western world (Puhl & Heuer, 2009) there could be reluctance to apply a label with undesirable connotations to the self or to others. As such, it was unclear whether underestimation of overweight and obesity was the byproduct of bias and/or denial (Katz, 2015) or due to a genuine inability to accurately identify overweight and obesity visually. Chapters 2 and 3 demonstrate that the weight status of men and women with overweight and obesity is frequently underestimated when there is no apparent benefit for the observer in underestimating weight status. The observers in these studies completed an online survey confidentially, in a private setting and were asked to judge the weight status of anonymous individuals. As such, these findings suggest that underestimation of overweight and obesity may be due to a genuine inability to visually categorise weight status accurately.

In further support of a visual explanation of weight status misperception, Chapters 2 and 3 provide support for a visual norm based explanation for underestimation of overweight and obesity. Previous research has suggested that underestimation of overweight is more likely in areas with a higher prevalence of obesity (Burke, Heiland, & Nadler, 2010; Robinson & Hogenkamp, 2015) and amongst those with more overweight social contacts (Ali et al., 2011; Maximova et al., 2008). Furthermore, studies have shown

that exposure to different body weights can affect future visual judgements and preferences about weight (Boothroyd, Tovée, & Pollet, 2012; Glauert et al., 2009; Robinson & Christiansen, 2014; Winkler & Rhodes, 2005). However, there has not been a comprehensive examination of why exposure to heavier bodies might affect underestimation or visual judgements about weight. Visual norms are thought to provide an important point of reference in visual judgements (Panis et al., 2010; Winkler & Rhodes, 2005), but the exact type of norm comparison process which could affect visual judgements of weight status was unclear. As discussed above, the body size norm could function as a prototype; whereby a single body which represents the average serves as the point of reference when making judgements about a target body (Panis et al., 2010; Winkler & Rhodes, 2005). Alternatively, categorical perceptions of body weight could act as a frame of reference in visual judgements; whereby a range of bodies are considered to be normal and it is only when a target body falls outside of this range it is perceived as being overweight (Tovée et al., 2012). Chapter 3 brings together this literature on weight misperceptions for the first time and provides the first support for a categorical norm based explanation for underestimation of weight status.

As well as clarifying the type of norm comparison that occurs in visual judgements about weight, the visual norm based theory of underestimation which is supported in Chapters 2 and 3 may also explain cultural and demographic differences in underestimation of overweight and obesity (Robinson & Hogenkamp, 2015). As discussed above, a cross cultural study found that underestimation of overweight and obesity was more likely in countries with higher national rates of obesity (Robinson & Hogenkamp, 2015). Exposure to heavier bodies would occur more frequently in countries with higher obesity prevalence and this could result in increases in the size of bodies which are visually

perceived as falling within the normal range. As a result of this, heavier bodies may not be identified as deviating from normality.

Similarly, the visual norm based theory of underestimation could explain why male overweight and obesity are more frequently underestimated than female overweight and obesity (Brug, Wammes, Kremers, Giskes, & Oenema, 2006; Robinson & Oldham, 2016). Chapter 3 shows that there is a difference in the body sizes that are visually perceived as being normal for men and women, whereby the largest body size considered to be normal for women was slimmer than the largest body size considered to be normal for men. The discrepancy in these norms in part explained the gender differences in frequency of underestimation in Study 2, Chapter 3. Gender differences in visual body size norms could be influenced by exposure to different body weights through the media. Female actresses and models are more likely to be underweight than their male equivalents (Fouts & Burggraf, 2000; Silverstein, Peterson, & Perdue, 1986) and the idolization of the thin female form is common in magazines and advertising (Malkin, Wornian, & Chrisler, 1999; Spitzer et al., 1999). Exposure to very thin females in this context could create a downwards shift in the size of bodies which are perceived as being normal for women. This could lead to more accurate identification of female overweight and obesity and could even lead to overestimation of weight status. In line with this, there is evidence that women are more likely to overestimate their weight status than men (Brug et al., 2006; Park, 2011). Furthermore, overestimation of weight status is associated with body dissatisfaction (Kim & Lee, 2010), disordered eating behaviours (Conley & Boardman, 2007) and unhealthy weight control behaviours (Park, 2011). Visual norms may be important in explaining a large body of literature which finds that exposure to thin ideal media has an adverse effect on female body satisfaction (Bessenoff, 2015; Harper & Tiggemann, 2008; Hawkins, Richards, Granley, & Stein, 2004; Ogden & Mundray, 2002) and research which

finds an association between media consumption and eating disorder symptomology (Harrison, 2000; Harrison & Cantor, 1997). Exposure to thin bodies could cause a downwards shift in the range of bodies that are considered to be normal in size. This could cause healthy weight women to think they are overweight and to become dissatisfied with their body size (Conley & Boardman, 2007; Park, 2011). As such, the visual norm based theory of underestimation could contribute to a body of literature which examines the effect of thin ideal advertising on weight perception and body image (Bessenoff, 2015; Harper & Tiggemann, 2008; Hawkins et al., 2004; Stice, Spangler, & Agras, 2001).

Chapter 4 also makes original contributions to the existing literature. Until recently, the prevailing view of weight misperceptions has been that underestimation of overweight is a barrier to weight loss, as accurate identification of health risk is thought to be crucial in determining behaviour change (Duncan et al., 2011; Kuchler & Variyam, 2003; Rosenstock, Strecher, & Becker, 1988). However, a contradictory body of recent research opposes this view and suggests that self-identification of overweight is associated with worse weight management over time (Duong & Roberts, 2014; Robinson et al., 2015). Weight gain in these studies occurred irrespective of the accuracy of the self-identification of overweight (Duong & Roberts, 2014; Robinson et al., 2015) and individuals with objectively normal weight BMIs are also at heightened risk of weight gain if they self-identify as being overweight (Cuypers et al., 2012). The majority of studies lending support to this body of research are observational and limited in that they cannot draw causal conclusions regarding the role of self-identification of overweight on weight gain. Only one study had previously examined the effect of the psychosocial experience of feeling overweight on eating behaviour in an experimental context. This study found support for the hypothesis that taking on the psychosocial experience of overweight resulted in increased snack food consumption, but the mechanism explaining this effect

was unclear. Chapter 4 of this thesis supports this new body of research and builds on the findings of this one experimental study by showing that taking on the psychosocial experience of overweight leads to increased snack food consumption in women, but not men.

Chapter 4 also aimed to further the current literature by examining why self-identification of overweight can lead to over-eating. Across two experimental studies a number of potential explanations were examined including; an increase in fear of negative appraisal or body concerns, reductions in self-control or negative affect as a result of anticipated stigma and perspective taking accounts which suggested that taking on the identity of overweight might result in stereotype consistent behaviour (e.g. over eating). I did not find evidence in support of any of these individual theories. However, noting a consistent lack of evidence for a hypothesis is of importance. For example, fear of negative appraisal from others was examined via an experimental manipulation in Study 1 and was also examined in both Studies 1 and 2 by way of a questionnaire which asked participants the extent to which they felt rejected, excluded and that others were making negative judgements about them. Yet, I found no evidence that it explained why women who wore the obese body suit consumed more snack food than women who wore the control clothing. As such, it is unlikely that this particular explanation is responsible for the effects of the body suit on snack food consumption as it was thoroughly examined across two studies and did not elicit any significant findings.

There are other factors which could explain the effect of the psychosocial experience of feeling overweight on eating behaviour. One factor which was not examined in the current thesis was stress. Stress is a theoretically distinct construct from negative affect (Lazarus & Folkman 1984) which has been consistently linked with the drive to eat (Groesz et al., 2012) and increased consumption of calorie dense foods (Epel et al., 2001).

Furthermore, a previous study showed that stress induced eating mediated the effect of self-perceived overweight on weight gain over time (Robinson et al., 2015). There are also a number of individual differences which could moderate the effect of the obese body suit on snack food consumption. For example, an individual's tendency to 'eat to cope' is one factor in particular which warrants further attention. Eating to cope quantifies the extent to which people are motivated to eat in response to negative affect (Lokken & Boggiano, 2013). Eating to cope is associated with heavier BMI (Boggiano et al., 2014) and eating to cope motivations are associated with weight gain over time (Boggiano et al., 2015). As the obese body suit has been shown to elicit negative affect in Chapter 4 and in previous research (Incollingo Rodriguez et al., 2016), it is possible that eating to cope could moderate the effect of the body suit on snack food consumption.

Although I did not find evidence to support mediation of the effect of the psychosocial experience of feeling overweight on snack food consumption by any of the potential mechanisms examined in Chapter 4, I did find evidence that taking on the psychosocial experience of overweight impacted on a number of these factors. For example, taking on the psychosocial experience of overweight consistently resulted in increased negative affect in Studies 1 and 2 of Chapter 4. This is in line with literature which finds an association between perceived overweight and depression (Al Mamun et al., 2007; Atlantis & Ball, 2008; Roberts & Duong, 2013). Although negative affect was not associated with snack food consumption in Studies 1 and 2 of Chapter 4, negative affect has consistently been linked with increased consumption in a number of experimental studies (Agras & Telch, 1998; Chua et al., 2004; Jansen et al., 2008; Schotte et al., 1990). As such, this is one potential mechanism which may require further attention in subsequent studies. Furthermore, in Study 2 of Chapter 4 wearing the obese body suit resulted in decreased effortful self-control. The effect of the obese body suit on self-control

in this study is supportive of literature which suggests that feeling rejected can have a detrimental impact on self-control (Baumeister et al., 2005). It could also lend support to the strength model of self-control (Baumeister et al., 2007; Hagger et al., 2010; Muraven et al., 1998), as it is possible that exerting self-regulation in order to cope with the demands of wearing the obese body suit in a public setting caused ego depletion. This may explain why participants in the obese body suit conditions performed worse on the second measure of self-control. Although this did not appear to affect eating behaviour in this study, reduced self-control could affect weight management through other pathways. For example, lower trait self-control has been associated with decreased physical activity (Crescioni et al., 2011).

Our findings are largely consistent with existing theories of weight stigma. The weight related social identity threat model of weight stigma suggests that individuals who perceive themselves as overweight are more likely to worry about negative appraisal from others (Hunger et al., 2015; Major et al., 2013) which can cause stress and undermine self-regulation (Hunger et al., 2015). Our results provide partial support for this theory as participants who wore the obese body suit, relative to control clothing, reported greater self-presentation concerns in both studies in Chapter 4. Furthermore, in Study 2 of Chapter 4 wearing the obese body suit resulted in decreased effortful self-control. However, we had hypothesised that in Study 1 of Chapter 4 the obese body suit would have a larger effect on snack food consumption in the public conditions relative to the private conditions but we did not find evidence to support this. The Cyclic Obesity/Weight Based Stigma (COBWEBS) model characterises weight stigma as a positive feedback loop whereby experiencing weight stigma leads to weight gain (Tomiyama, 2014). In the COBWEBS model weight stigma is defined as a stressor which leads to weight gain via a number of behavioural, physiological and psychological mechanisms. These mechanisms include

cortisol release, impairments to self-control and eating to cope in response to negative affect (Tomiyama, 2014). Again we found some evidence in support of this theory as taking on the psychosocial experience of overweight led to negative affect and reduced effortful self-control, although these factors did not mediate the effect of the obese body suit on snack food consumption in the two studies reported in Chapter 4.

5.4 Applied Relevance

This thesis has interesting applications in terms of intervention strategies aimed at tackling obesity. In isolation Chapters 2 and 3 could be interpreted as being suggestive of the need for a public health campaign aimed at promoting more accurate perceptions of what normal weight, overweight and obese bodies look like. However, in order to understand the applied relevance of the first half of this thesis it is important to look at the wider context of accurate identification of obesity in an environment in which individuals with overweight and obesity are stigmatised (Puhl & Heuer, 2009). The findings of Chapter 4 suggest that self-identification of overweight may not necessarily lead to better weight management, as the psychosocial experience of temporarily feeling overweight in these studies led to increased snack food consumption in women. When taken in conjunction with research which shows that identification of overweight is associated with greater body dissatisfaction, negative affect and internalised weight stigma (Essayli et al., 2016) and increased weight gain over time (Duong & Roberts, 2014; Robinson & Sutin, 2016; Robinson et al., 2015), this work suggests that promoting accurate weight perceptions alone may not be the answer to the obesity epidemic. This is in opposition with recent public health campaigns that have been aimed at promoting greater recognition of childhood overweight and obesity amongst parents. For example, there has been a move towards school based BMI measurement programmes where students are weighed and

objective BMI information is sent home to parents (Chomitz, Collins, Kim, Kramer, & McGowan, 2003; Michigan Department of Education, 2001; Nihiser et al., 2009). At least thirteen states in the US have implemented school based BMI measurement programmes (Nihiser et al., 2009) and these programmes generally have good support amongst parents (Chomitz et al., 2003; Kubik, Fulkerson, Story, & Rieland, 2006). In one study, 78% of parents thought it was important for schools to measure child height and weight and wanted to receive information about child BMI (Kubik et al., 2006).

In line with the findings in Chapter 4, previous research has shown that accurate parental recognition of child overweight and obesity is not associated with better weight management (Neumark-Sztainer et alk., 2008) and is associated with elevated future weight gain (Robinson & Sutin, 2016). The literature evaluating the utility of BMI measurement programmes is currently limited (Nihiser et al., 2009), but Chomitz et al. (2003) examined the effect of personalised weight information about child's weight on parental recognition of weight status, concern about child weight and implementation of weight control behaviours. Parents who received information about their child's overweight weight status were more likely to accurately identify their child as being overweight and were more likely to report initiating or intending to initiate weight control behaviours (Chomitz et al., 2003). However, this did not translate to behaviour change, and parents who received information about their child's overweight weight status were no more likely to implement preventative measures such as serving five portions of fruit and veg a day, limiting TV watching or promoting physical activity (Chomitz et al., 2003). A recent study compared students just below and above the cut off for the overweight BMI range (0.5 SDs from a BMI of 25), and examined the effect of being notified that you are overweight on subsequent BMI whilst controlling for baseline BMI (Almond, Lee, & Schwartz, 2016). Notification of being overweight was associated with increased weight

gain amongst female students but not male students (Almond et al., 2016). This study suggests that notifying individuals that they are overweight may have no beneficial effects on weight management and may be associated with weight gain amongst women.

An alternative approach more in line with the findings of this thesis is promoting healthier behaviours without an emphasis on weight or weight loss. A shift from weight centred to health centred interventions is becoming more popular and some researchers are adopting a “health at every size” (HAES) approach to interventions (Bacon, 2003; Provencher et al., 2007). Unlike more traditional approaches, HAES approaches do not consider weight loss as an important variable in intervention strategies (Bacon, 2003; Robison, 2005) and argue that improvements in health can be made independently of weight loss (Bacon, 2003; Miller, 2005). Unlike more traditional dieting approaches, HAES interventions focus on a holistic view of health and suggest that an emphasis should be placed on feeling good about oneself, enjoying a varied and healthy diet and increasing activity for enjoyment and increased quality of life (Robison, 2005). Provencher et al. (2007) compared the short term effects of a HAES approach on several measures of appetite and eating behaviours to a control group and a group which received social support via group meetings but did not receive clinical advice. The HAES participants reported a reduction in susceptibility to hunger and desire to eat relative to the social support and control groups. Although there was a significant reduction in weight within the HAES group and not in the control or social support groups, there were no significant between group differences in terms of weight loss (Provencher et al., 2007).

Another study compared a HAES approach with a traditional dieting approach; whereby they allocated women to complete a dieting or HAES programme for 6 months. Outcome variables including physiological (blood lipids, blood pressure, weight), behavioural (levels of activity and eating behaviour) and psychological factors (depression

and self-esteem) were measured after the 6 month intervention and again at 1 and 2 year follow ups (Bacon, Stern, Van Loan, & Keim, 2005). In terms of weight loss the dieting group lost a significant amount of weight after the 6 month intervention and this was maintained at the 1 year follow up but not at the 2 year follow up by which time the dieters had regained weight. The HAES group did not lose weight but did not gain weight over the course of the two years. The HAES group had significantly lower cholesterol at the two year follow up than at baseline, whereas the dieting group's measures of cholesterol did not differ between baseline and the two year follow up. However, the between groups analysis did not reach significance so the two groups did not differ significantly in terms of the changes to their blood lipids over the course of the two years. There were between group differences in the psychological measures whereby the HAES group reported significantly lower dietary restraint than dieters at each time point and more body satisfaction and higher self-esteem at the two year follow up than the dieting group. The HAES group therefore did not see any physiological improvements over and above the dieting group, but there were significant improvements in terms of body satisfaction and self-esteem relative to the dieting group (Bacon et al., 2005).

More generally this thesis could be applied to the question of whether or not HCPs should actively tell people that they are overweight. Although there is evidence which suggests that identifying as being overweight may lead to worse weight management (Duong & Roberts, 2014; Robinson et al., 2015) it would be ethically questionable to withhold information about weight. As such, an alternative approach would be to ensure that information about weight is delivered in a non-stigmatising way and to build in psychological support in weight loss interventions to help participants overcome the negative effects of self-perceiving themselves as overweight. Previous research showed that stress induced overeating mediated the effect of self-perceived overweight on weight

gain (Robinson et al. 2015) so techniques aimed at helping participants in weight loss trials manage stress may be valuable. One such approach focuses on mindfulness, mindfulness based stress reduction (MBSR) programmes are psychoeducational approaches which teach participants to take time to meditate and pay attention to their thoughts and feelings without trying to change or suppress anything (Bishop, 2002). A recent meta-analysis evaluated MBSR techniques in clinical and non-clinical samples and found supportive evidence for their efficacy (Grossman, Niemann, Schmidt, & Walach, 2004), suggesting MBSR techniques may be useful in reducing stress. This could be a helpful component in future weight loss interventions.

5.5 Strengths and Limitations

There are strengths of the empirical work conducted throughout this thesis. Cover stories were used and participant's beliefs about the aims of studies were recorded in order to rule out demand characteristics influencing the results observed. I also relied on validated scales and tasks where possible in order to ensure that psychological processes and behaviours were sensitively measured. However, the work in this thesis is not without limitations. All of the studies in Chapters 2 and 3 were limited due to the predominantly Caucasian ethnicity of both the models and participants as the effect of ethnicity on body size norms and underestimation of overweight and obesity could not be explored. Studies suggest that identification of overweight (Dorsey et al., 2010) and body size norms (Kemper et al., 1994) can be affected by ethnicity, so further work in more diverse samples would now be valuable.

Another limitation of both Chapters 2 and 3 is the stimuli used in Studies 1-5. The stimuli were photographs of men and women that were collected at different Universities. Based on a pilot study, I selected photographs of men and women which scored similarly

on several visual dimensions (e.g. tightness of clothes) for use in all studies in this thesis. However, as the two photograph sets were collected at different Universities there are some differences between the two in terms of the background and colour. Furthermore, all the models in the stimuli were dressed in clothes. Clothes could make it harder to accurately judge weight and visual weight estimation may have been more accurate if the models had been shown in underwear or bathing costumes. The decision to have models clothed was made in order to mimic the way that people are exposed to others in everyday life. In Study 3 of Chapter 3 I used standardised images taken from a validated scale (Harris et al., 2008). The findings of Study 3 followed the same pattern of results as Studies 1-3 of Chapter 2 and Studies 1-2 of Chapter 3. A final limitation of the stimuli is that it may be more difficult to judge weight status in a 2D image than in real life. It is possible that if participants evaluated models in a video or in person that estimation of weight status would have been more accurate. However, there are a number of research studies which show that underestimation of overweight and obesity occurs when observers meet the targets in real life (Bardia et al., 2007; Bramlage et al., 2004).

One of the main limitations of Chapter 4 is that it is unclear how closely wearing an obese body suit resembles the actual psychosocial experience of identifying as overweight. The lived experience of being overweight in a hostile environment could be argued to differ substantially from the experience of a normal weight individual temporarily wearing an obese body suit (Meadows, Danielsdottir, Calogero & O'Reilly, 2017). However, as discussed throughout this thesis, previous research suggests that perception of overweight may be more important in predicting psychological (Atlantis & Ball, 2008; Jones et al., 2010) and physical (Duong & Roberts, 2014; Robinson et al., 2015) health outcomes than objective BMI and participants who wore the obese body suit in Study 2 of Chapter 4 reported feeling overweight. Furthermore, experimentally manipulating the experience of

overweight using an obese body suit enables us to examine the psychosocial perception of overweight without confounding variables which may be present in observational studies (Duong & Roberts, 2014; Robinson et al., 2015). Body suit studies should not be used in isolation to advance our knowledge of the psychosocial experience of overweight but they do complement a body of research which explores the association between the actual experience of perceived overweight and weight management (Duong & Roberts, 2014; Jones et al., 2010; Robinson et al., 2015).

The samples of the two studies in Chapter 4 may also be limited as the majority of participants were aged 18-21. Young women are particularly susceptible to concerns about weight and shape (Grossbard, Lee, Neighbors, & Larimer, 2009; Lowery et al., 2005) and it is possible the effects found in Studies 1 and 2 of Chapter 4 would not be replicated in an older sample. The two studies in Chapter 4 also fail to examine the longevity of the effect of the psychosocial experience of overweight on eating behaviour. Although the studies reported an increase in snack food consumed at one eating occasion it is currently unclear whether this effect would be observed in the long-term. Understanding whether feeling overweight affects eating behaviour over a longer period would be required to provide compelling support for observational research which suggests that the psychosocial experience of overweight is associated with weight gain (Duong & Roberts, 2014; Robinson et al., 2015).

5.6 Future Directions

Although the studies discussed in this thesis provide insight into visual underestimation of overweight and the effect that the psychosocial experience of identifying as overweight has on snack food consumption, there are several areas where further research is required. Although Chapters 2 and 3 provide convincing support for a norm based account of

underestimation of overweight, these studies focused on judgements which were made about unknown others. There is also a high level of personal (Andrade et al., 2012; Edwards, Pettingell, & Borowsky, 2010; Robinson & Oldham, 2016) and parental (Lundahl & Kidwell, 2014; Parry et al., 2008; West et al., 2008) underestimation of overweight and obesity and it is currently unclear whether the visual norm based explanation of underestimation also explains underestimation of weight in these contexts. Future studies should examine whether visual body size norms are also associated with personal and parental underestimation of overweight.

One of the aims of this thesis was to examine the mechanisms which explained why the psychosocial experience of overweight affects snack food consumption. I did not find support for any of the mechanisms examined in Chapter 4 of this thesis. Although it is possible that the measures used in this study were not sensitive enough to detect mediation, it is also possible that the mechanism explaining the effect of feeling overweight on eating behaviour is something which was not examined. As discussed in Chapter 4 and in the theoretical implications section, there are various factors, such as stress or eating to cope, which may mediate or moderate the effect of the psychosocial experience of overweight on consumption and future research should continue to explore these factors.

The longevity of the effect of the obese body suit on eating behaviour should also be explored. Previous research suggests that self-identification of overweight leads to weight gain over time. Although the findings show that the experience of feeling overweight leads to increased calorie consumption at one eating occasion, it is not clear from the current studies whether participants compensated for this increase in calories over the course of the day by eating less at later meals. Future research examining whether the psychosocial experience of overweight would affect eating behaviour over multiple meals would be valuable. Participants could be asked to wear the obese body suit over the course of a

longer period of time (1-2 days) and the effect of the obese body suit on multiple eating occasions could be examined. If the obese body suit led to an increase in calories consumed across numerous eating occasions this would provide support for the theory that taking on the psychosocial experience of overweight could lead to weight gain over time.

Future research should examine the efficacy of intervention approaches which take in to account the link between self-identification of overweight and weight control behaviours. Previous research including the Health Belief Model has stated that recognition of susceptibility to an illness is necessary to motivate behaviour change (Rosenstock et al., 1988) whereas the findings of Chapter 4 when taken in conjunction with other research (Duong & Roberts, 2014; Robinson et al., 2015) suggest that self-perception of overweight may not be helpful in terms of promoting weight management behaviours. This has implications for intervention approaches. Randomized control trials evaluating the effect that population level interventions aimed at correcting weight misperceptions have on body weight, would be informative. If self-identification of being overweight is detrimental to weight management, then as discussed in the applied relevance section, one possibility is for public health efforts to remove the emphasis on weight loss and instead focus on promoting healthier behaviour. An alternative solution to the issue of promoting weight loss in an environment where identifying as overweight is likely to be unpleasant is to build psychological support in to weight loss interventions. As discussed above, one option is to include MBSR techniques in intervention programmes in an attempt to counteract the stress associated with identifying as overweight (Robinson et al. 2015). Further research is required to examine the efficacy of weight loss interventions which take into account the negative psychological outcomes self-perception of overweight can have on weight control behaviours.

More generally, this thesis suggests that work exploring techniques to reduce weight stigma may be valuable. As discussed in Chapter 4, weight stigma may in part explain why self-perception of overweight can affect eating behaviour and weight management behaviours as weight stigma is likely to make identifying as overweight unpleasant. Experiencing weight stigma is associated with negative psychological outcomes (Carr & Friedman, 2005; Friedman et al., 2005; Goldfield et al., 2010), increased food consumption (Puhl & Luedicke, 2012; Sutin et al., 2016), binge eating (Puhl & Luedicke, 2012), increased consumption of convenience foods (Sutin et al., 2016) and reduced physical activity (Vartanian & Shaprow, 2008). As such, reducing stigma may be a way of ensuring that identifying as overweight is not counter-productive. Puhl and Brownell (2003) suggest that the psychosocial origins of bias need to be understood in order to reduce weight stigma. Some work in this area suggests that attributions are important in reducing stigma (Crandall et al., 2001). Despite a wide body of literature which outlines the complex interaction of biological and environmental factors which contribute to adiposity (Egger & Swinburn, 1997; Kleiser, Schaffrath Rosario, Mensink, Prinz-Langenohl, & Kurth, 2009; Wilding, 2001; Wright & Aronne, 2012), many believe that obesity is the result of failings in self-discipline and that individuals with overweight are personally responsible for their health (Puhl & Brownell, 2001). The attribution-value model of prejudice suggests that stigma is exacerbated by this emphasis on personal responsibility (Crandall et al., 2001) and is supported by research which shows that personal attributions of blame for obesity are associated with greater anti fat attitudes (Crandall et al., 2001). Many studies have attempted to shift attributions of blame from the individual to external determinants in an attempt to reduce weight stigma, with mixed success. Some studies show that anti fat attitudes are reduced when a biological cause (e.g. a glandular disorder) is given for obesity (Crandall, 1994; Dejong, 2009) although this

finding is inconsistent (Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003). Much of this research is focused on changing anti-fat attitudes and not actual behaviour. However, an attitude-behaviour gap has been identified, whereby attitudes do not always predict behaviours (Aschemann-Witzel & Niebuhr Aagaard, 2014; Juvan & Dolnicar, 2014). Further research should examine whether experimentally manipulating attributions about the causes of overweight affects behavioural stigma and continue to explore and develop new methods for reducing anti-fat stigma.

Finally, the findings in Chapters 2 and 3 may be relevant to overestimation of weight status and the use of very slim female bodies in advertising. Adolescent girls (Park, 2011) and women (Brug et al., 2006) are more likely to overestimate their weight than adolescent boys and men. In one study, 29% of girls with objectively normal weight BMI overestimated their weight status and this was associated with maladaptive weight loss behaviours such as vomiting or taking laxatives or diet pills (Liechty, 2010). This is a consistent finding and a number of studies show that overestimation of weight status is associated with a number of adverse outcomes including; body dissatisfaction (Kim & Lee, 2010), disordered eating behaviours (Conley & Boardman, 2007) and unhealthy weight control behaviours (Park, 2011). The tripartite model of body image and eating disturbance (Thompson, Heinberg, Altabe & Tantless-Dunn, 1999) outlines three influences which can affect the development of body dissatisfaction and eating disorder symptomology in young women, these are; peers, parents and the media. Exposure to thin ideal advertising can have negative effects on body satisfaction (Harper & Tiggemann, 2008; Hawkins et al., 2004; Ogden & Mundray, 2002; Stice et al., 2001) and has been associated with eating disorder symptomology (Harrison, 2000; Harrison & Cantor, 1997). Visual body size norms could be important in explaining why media exposure to thin models can have a negative impact on body satisfaction and disordered eating. Exposure to very thin female

models in popular media could create a downwards shift in the range of female bodies which are visually perceived as being normal and this could lead to overestimation of female weight and greater body dissatisfaction. Future research examining whether exposure to thin ideal advertising leads to a downwards shift in the range of bodies which are visually perceived as being normal and whether this mediates the effect of thin ideal advertising on weight perception and body satisfaction would be informative. This could be achieved using a similar experimental paradigm to Study 3 of Chapter 3 but using images of very slim models versus normal weight models during the exposure stage and measures of body dissatisfaction or disordered eating as the outcome variable.

5.7 Conclusion

This thesis makes several original contributions to the existing literature. Chapter 2 shows that the weight status of men with overweight and obesity is frequently visually underestimated and that exposure to heavier body weights could increase the likelihood of visual underestimation of overweight. Chapter 3 provides convincing support for a categorical visual norm based theory of visual weight status underestimation, whereby exposure to heavier body weights results in larger bodies being perceived as within the normal range which leads to more frequent visual underestimation of overweight. Furthermore, Chapter 3 demonstrates that the largest body size which is perceived as being normal is slimmer for women than men which explains why underestimation of female overweight and obesity is less common than male overweight and obesity. Finally, Chapter 4 shows that the psychosocial experience associated with feeling overweight may lead to increased snack food consumption in women but not men, although the mechanisms underlying this effect are not yet clear.

5.8 In Summary

This thesis shows that the weight status of men and women with overweight and obesity is frequently visually underestimated due to increases in overweight and obesity having changed the range of bodies which are perceived as being normal. Furthermore, it provides evidence that the psychosocial experience of feeling overweight can lead to increased snack food consumption in women. As such, this thesis has important implications in terms of weight misperceptions and for providing feedback to individuals with overweight and obesity about their weight status. Alone, population level interventions aimed at correcting weight misperceptions and improving the accuracy of identification of overweight and obesity are likely to be unhelpful in terms of reducing obesity. Infact, as the findings of Chapter 4 and previous research show that perceived overweight can affect eating behaviour and weight gain (Robinson et al., 2015; Duong & Roberts, 2014), an intervention of this kind could lead to increases in obesity over time. Instead, providing information about weight status needs to be considered in the wider context of weight stigma. Information about weight should be delivered sensitively in a non-stigmatising way. Identifying the mechanism or mechanisms which explain why identifying as overweight can affect eating behaviour and lead to weight gain over time should be a priority for future research. Identifying the mechanism or mechanisms would allow the integration of additional targeted psychological support in weight loss interventions to overcome the potentially harmful effects of identifying as overweight. Furthermore, future research aimed at reducing weight stigma more generally would be of value.

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