Social Norms and Reference Groups Relating to Eating Behaviours and Body Weight Judgements

by

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Thesis

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Declaration

This thesis is submitted to the University of Warwick in support of my application for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree.

Part of this thesis has previously been published by the author in the following:

Peer reviewed publications

The systematic review findings presented in chapter two have been published;

Clohessy, S., Walasek, L., & Meyer, C. (2019). Factors influencing employees' eating behaviours in the office-based workplace: A systematic review. *Obesity Reviews, 0*(0). Retrieved from https://doi.org/10.1111/obr.12920.

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Summary

People use others to inform their own eating behaviours and weight judgements. This thesis aimed to understand perceptions of social norms and reference groups in relation to eating behaviours and weight judgements.

Chapter 1 describes the key concepts and background information to understand the context of the current PhD thesis. It begins by introducing the concept of social norms. Followed by a summary of research studies that have investigated social influences on eating behaviours in general. Next, it discusses the key reference groups that people compare their eating behaviours with and considers social media as a reference group for eating behaviours. It presents research that suggests colleagues are an important reference group for eating behaviours.

Chapter 2 presents a systematic review investigating factors affecting eating behaviours in the office-based workforce. Findings suggest colleagues influence people's eating behaviour at work. Based on this, I employed a broader approach and explored some fundamental research questions; *How* do people make weight judgements? and *who* do they make weight judgements with? These questions formed the basis of studies in this thesis.

Chapter 3 discusses the implications of the systematic review findings and considers colleagues as an important reference group for body weight judgements. It considers what is known about who people compare themselves with to make a weight judgement and what is known about reference groups more generally. Next, a summary of theories of how people make body weight judgments and an introduction to rank based judgements. Then, a summary of the key points covered in chapters one, two and three. Finally, an outline of the objectives and aims of the thesis, as well as an overview of the thesis structure.

Chapter 4 provides an overview and background to the methods utilised in this thesis. First, an overview of study design, participant recruitment, and participant characteristics included within each of the studies are presented (studies 1-7). Then, a description of the research methods used within the thesis and discussion of the rationale for the methods used in each study and finally a chapter summary.

Chapter 5 examines whether people use perceived rank of weight with others to inform weight judgements and explored reference group composition. Three studies suggest people use *rank* with others to make a weight judgement, explaining the cognitive mechanisms behind *how* people make weight judgements. Friends and people the same gender are important reference groups for weight judgements.

Chapter 6 investigates whether people's judgments are sensitive to the rank position of a judged stimuli among other stimuli or if they are sensitive to the mean in a comparison context. Judgments of weight in context appear to be sensitive to the rank position of weight relative to the weights of others.

Chapter 7 explored perceptions of restrained eating in reference groups (Instagram/UK population). Two studies utilised a rank-based approach as an underlying mechanism to explain people's judgements towards their restrained eating, results were inconclusive.

Chapter 8 discusses theoretical and practical implications of all findings. People use rank to make judgements about weight. Findings support rank-based models of human judgment,

offering insight into the exact mechanisms by which people judge weight of themselves and others.

Acronyms

BMI	Body Mass Index
BSREC	Biomedical & Scientific Research Ethics Committee
DbS	Decision by Sampling
EDE-Q	Eating Disorders Examination Questionnaire
ANOVA	Analysis of Variance
Kg	Kilograms
St lb	Stone(s) and pound(s)
NHS	National Health Service
ONS	Office for National Statistics
WMG	Warwick Manufacturing group

Dissemination and Publications

Peer reviewed publications

The systematic review findings presented in chapter two have been published;

Clohessy, S., Walasek, L., & Meyer, C. (2019). Factors influencing employees' eating behaviours in the office-based workplace: A systematic review. *Obesity Reviews, 0*(0). Retrieved from https://doi.org/10.1111/obr.12920.

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Clohessy, S., Walasek, L., & Meyer, C. (2021). Exploring reference group composition when ranking weight with others. Appetite. (In press).

Conference presentations

- Oral presentation of the findings of study 2, chapter five: "Exploring reference group composition when ranking weight with others". British Feeding and Drinking Group, virtual poster presentation (2021).
- Findings of study 1, chapter five accepted to BFDG conference (cancelled due to the pandemic) "Social ranking effects on personal judgements of weight". British feeding and drinking conference (2020).
- Virtual poster presentation of preliminary findings from study 1, chapter five "Social rank effects and eating psychopathology". Eating Disorders Research Society, virtual poster presentation (2020).
- Oral and poster presentation of systematic review findings (chapter two), "Factors influencing employees' eating behaviours in the office-based workplace: A systematic review"**.** Food GRP Interdisciplinary conference entitled 'Food Encounters': A Network Conference' (2020).

Invited presentations

Chapter two, systematic review findings were adapted for an evidence-based talk to a postgraduate audience ***'****How to improve your eating behaviours whilst studying'*. Invited by the Postgraduate Community Engagement Team, University of Warwick (2019, 2020).

Article prepared for publication

Chapter six, studies 4 and 5 have been prepared for publication as: Clohessy, S., Meyer, C., & Walasek, L. (*in preparation*).(2021). Rank based sensitivity in subjective perception of weight.

Chapter 1: Introduction

1.1. Chapter 1 Overview

This introduction aims to describe the key concepts and background information to understand the context of the current PhD thesis. It begins by introducing the concept of social norms (section 1.2). Followed by a summary of research studies that have investigated social influences on eating behaviours in general (section 1.3). Next, it discusses the key reference groups that people compare their eating behaviours with (section 1.4) and considers social media as a reference group for eating behaviours (section 1.5). Section 1.6 presents research that suggests colleagues are an important reference group for eating behaviours.

1.2. What are social norms?

Social norm theories propose that people evaluate and choose their own behaviour, at least partly, with reference to their beliefs about what other people do (but this is often inaccurate) (e.g., Bicchieri & Dimant, 2019; Cialdini & Trost, 1998; Goldstein et al., 2008; Higgs, 2015; Legros & Cislaghi, 2020). Social norms can be defined *as implicit rules shared by society or members of the same group that guide us to action* (e.g., Higgs, 2015; Legros & Cislaghi, 2020). An important component of social norms is the reference group. The reference group refers to *relevant others whose actions or beliefs one considers when deciding what to do and whose behaviour and (dis)approval matter in sustaining the norm* (Bicchieri & Dimant, 2019). The reference group may be defined at different levels. For example, more broadly at the level of nationality or fellow students attending the same institution, or specific groups like colleagues, family and friends (Higgs, 2015). However, the relevant others that people recall when deciding how to behave may change depending on the social norm in question. For example, the UK population may set a 'social norm' of wearing a face covering in supermarkets. On the other hand, a friendship circle may set a 'social norm' of not eating meat. Indeed, research suggests that the more an individual identifies with a group, the greater their desire may be to emulate the 'in-group' behaviours and follow a specific social norm (Collins et al., 2018; Higgs, 2015). For example, students may use fellow students attending the same university as a reference group to guide their own behaviours. In this context, students who misperceive that other students consume a large quantity of alcohol, may be more likely to consume high amounts of alcohol as a result (Perkins, 2002).

Additionally, research suggests that beliefs about the social norm can often be biased. For example a study by Kuang et al. (2020) found that people who defecate in the open *overestimated* the prevalence of open defecation, whereas those who consistently use toilets *underestimated* it (Kuang et al., 2020). This finding suggests a false consensus bias in the perceived prevalence of open defecation. More broadly, the results suggest that those who

took part in a socially undesirable behaviour perceived a greater number of people also engaged in similar behaviour to themselves (Kuang et al., 2020). Applied to eating behaviours, it is possible that people who engage in high levels of restrained eating may (incorrectly) believe many other people also engage in this behaviour.

1.3. Social influences and eating behaviours

The previous section introduced the concept of social norms. This section will now focus on social norms research specific to eating behaviours. Evidence suggests that individuals often rely on their perception of the social norm to inform their own eating behaviours (e.g., Higgs, 2015; Lake et al., 2016; Park et al., 2017b; Prinsen et al., 2013; Thomas et al., 2017). In other words, people use the eating behaviours of others as a guide on how to act. Additionally, research studies have illustrated that people use social norms for guidance of *what* to eat (e.g., specific food items). For example, participants took part in an intervention that supplied them with fruit during the working day (Lake et al., 2016). Interestingly, participants reported an increase in fruit consumption of other people in the office (not taking part in the intervention). One explanation is the participants in the intervention 'modelled' eating fruit to other employees (Lake et al., 2016).

Research studies have also demonstrated that social norms are followed when people look for guidance on *how* much to eat (e.g., portion size) (Prinsen et al., 2013; Robinson et al., 2013). For example, research has found that if people dine alongside someone who eats a large amount, they are more likely to copy the same large portion as their dining partner and consume more than if they had eaten alone (Cruwys et al., 2015). Similarly, people tend to consume more food when in a group setting compared to when they eat alone (e.g., Cruwys et al., 2015; Ruddock et al., 2021). Furthermore, a study found that the eating behaviours of other people are even influential when other participants are not physically present, but information was communicated about the social norm (Prinsen et al., 2013). Specifically, participants selected more chocolates when the norm (empty chocolate wrappers) demonstrated that other people had eaten chocolates compared to the condition with no chocolate wrappers present.

In summary, it appears that people alter their eating behaviours depending on other people around them. Given this, it is important to consider exactly *who* has an influence on people's eating behaviours. This will be explored in the section below.

1.4. Eating behaviours and the reference group

As previously mentioned, the reference group is an important component of social norms. People care about the behaviour of the reference group and use their behaviour as a guide (Bicchieri & Dimant, 2019). Given this, it is important to consider who are influential reference groups in the context of eating behaviours. Research has identified several important

reference groups in relation to eating behaviour, including friends, family members, fellow students, and individuals people follow on social media platforms (e.g., Aldrovandi et al., 2015a; Chung et al., 2021; Sharps et al., 2021). Indeed, studies investigating social network analysis indicates that eating behaviours are similar within social circles, for example peers have been found to be similar in their consumption of unhealthy snack foods (e.g., de la Haye et al., 2013; Pachucki et al., 2011). An implication of similar diets could be similar body weight among members within the same social circle. For example, one research study suggested that obesity has been found to spread across social networks (Christakis & Fowler, 2007).

Studies have investigated people's perceptions of social norms and eating behaviours within reference groups. A recent study investigated perceived norms of meat consumption and plant- based meal intake (Sharps et al., 2021). Perceived descriptive norms were positively associated with plant-based meal frequency. Specifically, participants ate plant-based meals more frequently when they perceived their extended family, friends, and significant other to also frequently eat plant-based meals. Additionally, studies have found that perceptions of social norms and eating behaviours within a reference group can impact people's judgements towards their intake of a certain food type. Aldrovandi et al. (2015a) elicited student's beliefs about the chocolate bar consumption of other students. They found that participants who consumed a high number of chocolate bars showed no concern towards their own level of chocolate consumption if they believed many other students consumed the same or more (Aldrovandi et al., 2015a). This study demonstrates that beliefs about other people's behaviour can influence subjective judgements. It also suggests that people make judgements about their own eating behaviours by comparing themselves to the eating behaviours of others.

1.5. Social media: a reference group for eating behaviours

More recently, perceived norms and eating behaviours have been investigated in the context of social media. Social media refers to social networking sites that are interactive in nature and where content is generated by the user (e.g., images, comments) (e.g., Chung et al., 2021; Ventola, 2014). It has been suggested that individuals people follow on social networking sites may be an important reference group for eating behaviours (e.g., Hawkins et al., 2020). Facebook is one social media platform that has been investigated in relation to social norms and eating behaviours. For example, one study reported that participants' own self-reported fruit and vegetable consumption was associated with the perceived level of fruit and vegetable consumption of Facebook users (Hawkins et al., 2020). However, this study did not compare participants beliefs about fruit and vegetable consumption on Facebook to that of the general population or another reference group. To understand people's beliefs of eating behaviours on social media platforms in further depth, it could be interesting to explore people's beliefs on social media in context of another reference group.

Research has also investigated the influence of Instagram on people's eating behaviours (Pilař et al., 2021; Turner & Lefevre, 2017). Instagram is an image-based social media platform. This in turn may make people feel more connected to individuals they follow and potentially more likely to copy their eating behaviours (Turner & Lefevre, 2017). For example, people may follow others online that promote a particular way of eating e.g., only consume very healthy foods (e.g., this is known as "orthorexia" which can be defined as a preoccupation with healthy food often resulting in dietary restriction (Cheshire et al., 2020). Indeed, Turner and Lefevre (2017) found that higher Instagram use was associated with higher orthorexia symptoms. The authors proposed this finding could be explained via selective exposure to pictures, as users select who they wish to follow online, and as a result they are exposed to other accounts with similar content. However, it should be noted that this was a cross-sectional questionnaire and therefore causation is unclear.

Research has found that social media use (including Instagram) is associated with restrained eating (e.g., Fardouly et al., 2017; Rounsefell et al., 2020). Restrained eating can be defined as attempts at restrictive eating in order to influence one's weight or shape, regardless of whether someone is successful or not (Polivy et al., 2020). It can be measured using the Eating Disorders Examination Questionnaire restraint sub-scale which consists of five questions (e.g., *"Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?"*) (Fairburn & Beglin, 1994). Despite restrained eating being associated with Instagram use, there is no research on the perceived social norms of restrained eating on Instagram or in fact any other reference group. This is important because social norm theories propose that people evaluate and choose their own behaviour at least partly with reference to their beliefs about what other people do (which is often inaccurate) (Aldrovandi et al., 2015a). As discussed earlier in section 1.3, perceptions of other people's eating behaviours can influence people's own eating behaviours (e.g., Thomas et al., 2017). Therefore, if people base their judgements on what specific reference groups do with regards to eating, it may lead to biased judgements. In the context of Instagram, users may follow people promoting one specific way of eating. Consequently, this may make behaviour or values i.e., eating behaviours appear more widespread than they actually are (Salathé & Khandelwal, 2011). It is unclear how someone's perceptions of the social norms of restrained eating on social media platforms i.e., Instagram (where it might be highly concentrated) compares to that of the UK population. Therefore, understanding perceptions of restrained eating will form the focus of two studies within this thesis (studies 6-7, chapter 7).

The above section has considered possible reference groups for people's eating behaviours, with a specific focus on social media. However, other possible reference groups to consider as an influence on an individual's eating behaviours are those with whom they

frequently interact, including people working in the same organisation. The following section will focus on exploring this influence.

1.6. Eating behaviours and colleagues

As discussed in earlier sections of this introduction, research investigating the social influence of other people and eating behaviours have focused on reference groups such as friends, people on social media platforms and fellow students (e.g., Aldrovandi et al., 2015a; Pachucki et al., 2011; Turner & Lefevre, 2017). However, another key reference group to consider for eating behaviours may be colleagues. People in the workplace make up a large proportion of a person's environment during the working week and have the potential to influence an individual's eating behaviours in both positive and negative ways (e.g., Chancellor et al., 2017; Wang et al., 2014).

Some evidence suggests that people care about the perception of social norms in relation to eating at work (e.g, Park et al., 2017b; Payne et al., 2013; Thomas et al., 2017). In other words, people care about *what* (specific food consumed by others) and *how* their colleagues eat at work (e.g., eating lunch alone at their desk). It is possible that people might use information about what other people do regarding eating at work as a guide for their own eating behaviour in the workplace. This effect has been demonstrated experimentally. For example, a work-based intervention focused on increasing vegetables purchased with a lunchtime meal (Thomas et al., 2017). Exposure of employees to a descriptive norm message *"Most people here choose to eat vegetables with their lunch"* led to an increase in purchases of vegetables with meals, with the effect still observed six weeks later (Thomas et al., 2017).

Workplace and eating behaviours have been investigated in the context of nurses in a hospital environment. A previous review investigated factors affecting healthy eating behaviours among nurses (Nicholls et al., 2017). The review found that most workplaces create barriers to healthy eating. The authors reported four main barriers in the workplace, which were positively associated with overconsumption of unhealthy foods high in sugar, salt, and saturated fats. The four main themes were as follows; organisational-related barriers (e.g., long working hours), individual factors (e.g., nutritional knowledge), workplace environment (e.g., availability of healthy food in the workplace canteen) and social influences at work (e.g., pressure from colleagues). However, it is unclear if the findings of the review by Nicholls et al. (2017) can be generalised to more sedentary job roles like office workers.

Alongside colleagues, there are several work-related factors that might influence eating behaviours in the office-based workplace. For example, research has focused on the influence of the physical food environment at work on people's eating behaviours (Allan et al., 2017). Several interventions have elicited changes to the physical microenvironment to help guide employees to purchase healthier food choices at work e.g., reduced portion sizes, calorie labels on products (e.g., Hollands et al., 2018; Vasiljevic et al., 2018). However, it is currently

unclear if there are other factors that affect eating behaviours of individuals working in an office-based workforce which may be used to inform future interventions. This formed the rationale for the systematic review, which will be presented in the next chapter.

1.7. Chapter 1 Summary

This chapter was the first chapter in the thesis. Chapter one introduced some of the main concepts covered in the thesis. Background literature relating to social norms, eating behaviours, and reference groups were discussed. Chapter two will present the findings of a systematic review exploring factors influencing employees' eating behaviours in the office-based workplace.

Chapter 2: Factors influencing employees' eating behaviours in the office-based workplace: A systematic review

2.1. Chapter 2 Overview

The following chapter presents the findings of a systematic review, which is a published article in Obesity Reviews, cited as: Clohessy, S., Walasek, L., & Meyer, C. (2019). Factors influencing employees' eating behaviours in the office-based workplace: A systematic review. *Obesity Reviews, 0*(0). Retrieved from https://doi.org/10.1111/obr.12920.

2.2. Abstract

Employees spend a large proportion of their time at work and typically consume a third of their total calories during the working day. Research suggests that the work- place environment can affect employees' eating behaviours, leading to various related health consequences. This systematic review aimed to identify and synthesize the evidence surrounding factors influencing eating behaviours within an office-based workforce. The literature search was restricted to studies published in English between January 2008 and April 2018. A total of 5,017 articles were screened and assessed for eligibility, of which 22 articles (*n* = 23 studies) were included in the review. All included studies were subjected to quality assessment and were summarized into groups (themes) of "factors" affecting any aspect of eating behaviour at work. The findings revealed a number of factors influencing eating behaviours at work relating to the job role, workplace food environment, and social aspects of the office-based workplace. Most of the existing research implies the office-based workplace has a negative influence on eating behaviours. The findings of this review provide an evidence based, comprehensive summary of the possible determinants of eating behaviours in the workplace, which may help researchers to identify factors that are potential targets for intervention.

2.3. Introduction

Working adults spend up to two thirds of their day in the workplace, and there is a growing pressure from the UK government for organizations to better support the health and well-being of their employees [see "Thriving at work" report Farmer and Stevenson (2017)] (ONS, 2018). Given that a typical working adult consumes approximately a third of their daily calorie intake in the workplace, eating behaviours have been identified as a key determinant of employees' well-being and productivity (e.g., BDA, 2017; Hartline-Grafton et al., 2010; Johnson et al., 2007; Lima et al., 2018; Lindseth et al., 2011; Public Health England, 2017). Eating behaviour is a broad term that encompasses a variety of decisions including what an individual chooses to eat (type of food), how much they eat (e.g., portion size), when they eat, and how

they choose to eat (e.g., eating alone/or with others) (Emilien & Hollis, 2017). In the short term, a diet low in nutrient-rich foods can affect employee's levels of concentration, mood, and performance (e.g., among pilots and students) (e.g., BDA, 2017; Belot & James, 2011; Florence et al., 2008; Johnson et al., 2007; Lindseth et al., 2011). In the long term, an unhealthy diet can contribute towards obesity, which can significantly increase the risk of cardiovascular disease, cancers, type 2 diabetes, and a number of mental health problems (e.g., Astbury et al., 2019; Nyberg et al., 2018; Simon et al., 2006). As discussed in a recent systematic review, workers with obesity have been associated with increased levels of absenteeism, reduced productivity, and higher costs for organizations (e.g., Allan et al., 2017; Dee et al., 2015; Fitzgerald et al., 2016).

Recent research has focused on interventions aimed at physical inactivity, specifically reducing the amount of time spent sitting among office-based employees (Chu et al., 2016). Indeed, office workers have increased risk of physical inactivity compared with other manual professions, with full-time office workers spending up to two thirds of their working day sitting down (e.g., Chu et al., 2016; Lindberg et al., 2018). However, weight management is the result of total energy balance and given that eating behaviours contribute to it alongside physical activity, it is important to address eating behaviours of workers too (Emilien & Hollis, 2017). Additionally, with rising levels of automation of labour (e.g., Industry 4.0) and steady increase of office-based jobs, it is important to identify any specific factors in an office environment that impact on eating behaviours (Lasi et al., 2014). Taken together, there is a growing need to provide a better understanding of the barriers and facilitators of healthy eating among the predominantly sedentary workforce. This is the objective of the present systematic review.

The workplace also offers an interesting context for studying eating behaviours. There is often a high level of consistency in people's working lives, with many workers (particularly those who are office- based) spending most of their time in the same location surrounded by the same group of colleagues (Smedslund et al., 2004). Partly for this reason, a number of eating-related research has been conducted in organizations (e.g., Allan et al., 2017; Lake et al., 2016; Nicholls et al., 2017). Workplace eating interventions have typically focused on individual behaviour change, motivational interviewing, and nutritional education (Allan et al., 2017). However, previous systematic reviews of workplace dietary interventions have reported only moderate positive effects of such programs (e.g., Allan et al., 2017; Geaney et al., 2016; Geaney et al., 2013). One of the key challenges for interventions is the heterogeneity of factors affecting eating at work, which makes it difficult to accurately identify “what works” about a single intervention program (Smith et al., 2016; Vasiljevic et al., 2017). More recently, there has been an increase in interventions focusing on modifying elements of the workplace environment to increase healthy food choices. A recent review concluded that despite some

studies reporting positive changes in eating behaviour at work, poor reporting of interventions and control conditions made it difficult to evaluate their effectiveness (Allan et al., 2017).

In order to develop effective workplace interventions for healthy eating, researchers must first consider all of the known determinants of eating behaviour as potential targets for intervention, such as distinct features of working conditions. In a recent systematic review of factors affecting healthy eating among nurses, the majority of studies found that workplaces often create barriers to healthy eating (Nicholls et al., 2017). Nicholls et al. (2017) categorized those into four distinct themes: workplace environment (e.g., availability of healthy food in the workplace canteen), social influences at work (e.g., pressure from colleagues), individual factors (e.g., nutritional knowledge), and organizational-related barriers (e.g., work stress). All of these categories of factors have been found to be positively associated with the overconsumption of unhealthy foods high in sugar, salt, and saturated fats among nurses (Allan et al., 2017). Jobs in the health care sector often involve late night shift patterns and, arguably, are more physically demanding compared with the work of those who spend most of their time sitting at their desk (Kyle et al., 2017; Nicholls et al., 2017). Therefore, the findings of previous reviews are unlikely to be generalizable to other, more sedentary occupations such as office-based white-collar positions (Nicholls et al., 2017). Given that many employees work in office-based roles, there is a need to consider the full range of work-related factors that might affect employees eating behaviours.

In summary, what one consumes and how one eats at work can affect physical health, well-being, and work performance (e.g., BDA, 2017; Lindseth et al., 2011; Public Health England, 2017). A previous review investigating the eating behaviours of nurses found that the majority of studies reported barriers to healthy eating and few facilitators (Nicholls et al., 2017). However, a review of those factors affecting the eating behaviours of office-based workers is yet to be conducted. Therefore, the primary aim of this systematic review is to identify and critically evaluate the evidence for specific factors that influence work-based eating behaviours by office workers.

2.4. Methods

An electronic literature search was carried out using the following databases: PsycINFO, MEDLINE, and CINAHL. On the basis of the initial scan of the relevant literature, a decision was made to limit the scope of the review to articles published between January 2008 and April 2018. Nine key terms were used to search for relevant articles (workplace* or “work place*” or “work site” or worksite or work or employee*) AND (“eating behavio?r*” or diet or eating). Search terms were restricted to title, abstract, and keywords. The reference lists of all included articles were searched to ensure all relevant articles were included in the systematic review. A detailed search strategy is provided in Appendix 1.

Selection criteria

Studies were eligible if they met the following criteria:

- Population: Only studies with white-collar workers, or studies in which majority of workers are white-collar workers (a minimum of 50% and above, based on the sample description) working in an office environment in jobs that generally do not involve manual labour (e.g., bus drivers, nurses), were included (the same inclusion criteria as was applied by Chu *et al.* (2016). Studies in which it was impossible to unambiguously determine the distribution of occupational roles of participants were excluded (Mazzola et al., 2017; Tamers et al., 2015).
- Workplace setting: The review was limited to studies conducted within offices. Studies that utilized office-based workers that were conducted elsewhere (e.g., at home) were not included (Hagger-Johnson et al., 2017; Tabak et al., 2015), In addition, studies were excluded if they did not clearly specify the workplace setting (Thomas et al., 2017).
- Study design: Qualitative and quantitative studies were included, but systematic reviews, meta-analyses, and literature reviews were excluded. It is worth noting that many studies included in the review were intervention studies. Tests of interventions to improve healthy eating provide empirical evidence for factors that are likely to drive poor or good eating behaviours.
- Language: Only articles published in English were included.
- Eating behaviours: Primary outcomes of the studies included in this review were eating behaviours. As per our definition of eating behaviours (see Section 2.3), these included (a) objective measures of change in eating behaviour (e.g., change in consumption of fruit/vegetables eaten in workplace canteen meals), (b) objective measures of food choice (e.g., snack choice), (c) objective measures of food consumed (e.g., amount of fruit and vegetables consumed),(d) observational measures of food choice (e.g., snack choice), (e) subjective measures of eating behaviour (e.g., self-reported fruit/ vegetables consumed at work, self-report of eating habits at work, e.g., eating lunch with colleagues/eating alone), and (f) subjective measures of change in eating behaviour (e.g., self-reported increase of fruit consumed at work). Any studies based in an office, but which had assessed eating behaviours generally, with no reference to eating behaviours in the workplace, were excluded (e.g., Setto et al., 2016; Tsiga et al., 2015; van Strien & Koenders, 2011; van Strien & Koenders, 2012). Studies investigating physical activity alongside eating or multicomponent lifestyle interventions were included as long as eating behaviours at work were reported separately in the results section.

- Only peer-reviewed, published articles were included.

Article screening

The first author (S. C.) developed the search strategy and conducted the database searches, identifying and collating all potentially relevant articles. The first author then screened all titles and abstracts of identified articles against the inclusion and exclusion criteria. Full texts of potentially eligible studies were then retrieved. When there was uncertainty regarding inclusion/exclusion of a specific paper, the other authors were consulted (C. M. and L. W.) until unanimous agreement was reached.

Data extraction and synthesis

The following information was extracted from each study by the first author: the study design, workplace setting, participants, measure/s of eating behaviours, eating behaviour outcome, findings, conclusions. The review and narrative synthesis were guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for systematic reviews (Moher et al., 2009). Due to the heterogeneity between studies' methodologies, a meta-analysis was not considered appropriate. A narrative synthesis was used to enable inclusion of quantitative, qualitative and mixed-method study designs and refers to an approach to a systematic review and synthesis of findings from multiple studies that relies primarily on the use of words and text to summarise and explain the findings (Popay et al., 2006). A narrative synthesis approach was used to explore relationships within and between studies, this was then synthesised as part of the discussion. The primary goal of the analysis was to extract factors that influence eating behaviours among office-based workplaces. Factors here are defined as any aspect of the office workplace that might have an effect on some aspect of eating behaviours in the office environment, e.g., correlates, mediators, self-reported disclosure of factors in questionnaires/qualitative studies, and observations. Examples of factors might relate to the workplace environment, job role, or colleagues. In order to group these into themes, a qualitative evidence synthesis was performed jointly by all authors. This involved comparing the factors between all of the articles and looking for patterns within the factors using thematic analysis (Braun & Clarke, 2006). Factors were then arranged into sub themes e.g., ‘Food and eating facilities’ and then eventually higher order themes. This process was iterative to ensure that each theme and sub theme reflected the findings accurately and was performed by all authors.

Quality assessment

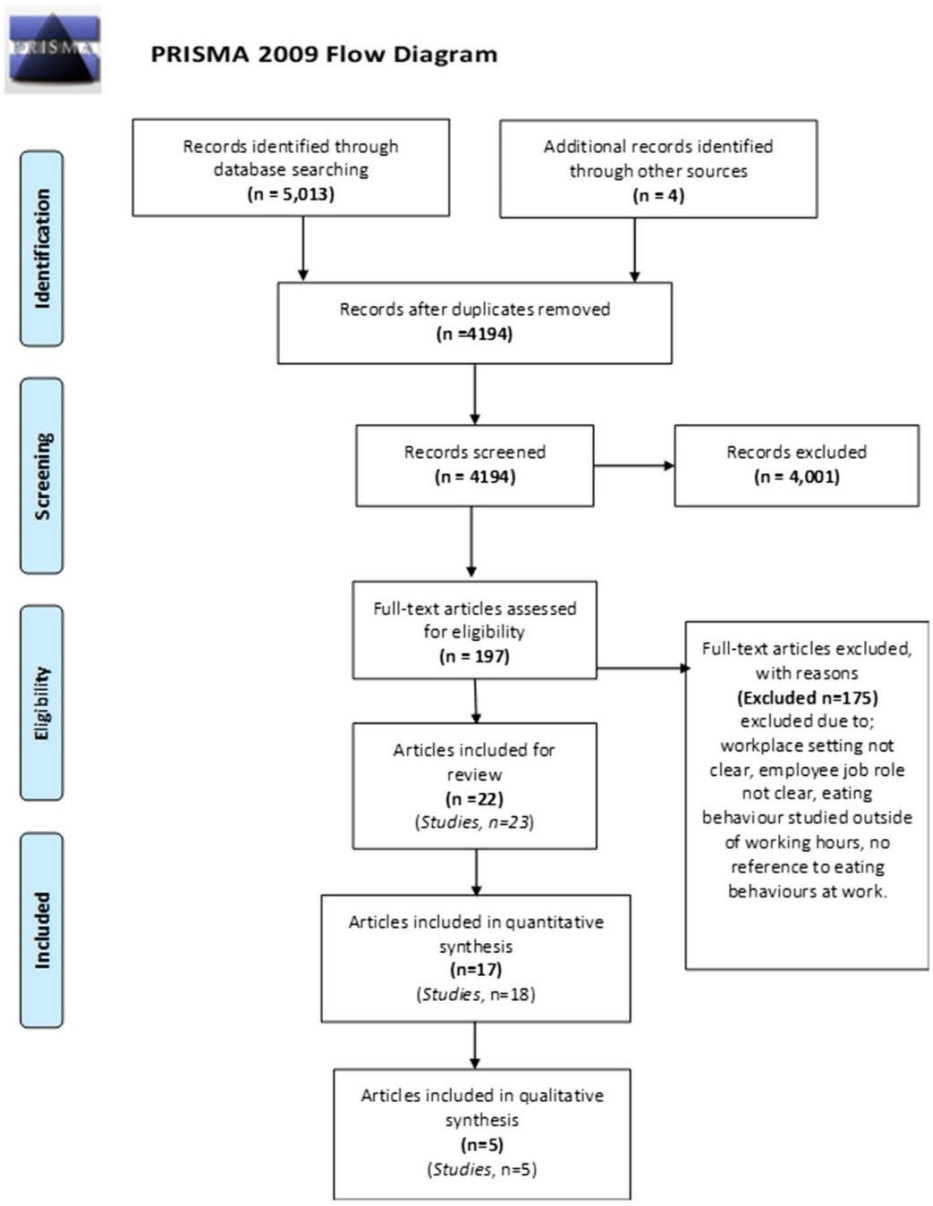
For the purposes of this study, an existing checklist for quality assessment of qualitative and quantitative studies was used (Littlewood et al., 2017). The assessment criteria is detailed in Appendix 2. An overall quality assessment score was calculated for each study, with scores of

0-3 indicating low quality, 4-6 moderate quality, and 7-9 high quality. Study quality was independently assessed by a second reviewer (following suggestions by (Moher et al., 2009).

2.5. Results

The initial database search resulted in a sample of 5,013 potentially relevant articles. A proportion of these were removed due to duplication (*n* = 823), and some additional (*n* = 4) articles were identified through other sources (e.g., internet search). The remaining articles (*n* = 4,194) were evaluated based on their title and abstract, removing those that were deemed unsuitable (*n* = 4,001). The remaining articles (*n* = 197) were downloaded for review against the inclusion and exclusion criteria. Following this step, 22 articles (containing 23 unique studies) were included in the final sample (Figure 1).

Figure 1 *Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart*



Characteristics of included studies

Studies included in the review often focused on different types of eating behaviour but primarily on (a) snacking, (b) eating lunch, and (c) general workplace eating practices. Three studies focused on consumption of snacks at work (e.g., Baskin et al., 2016; Lake et al., 2016; Sonnentag et al., 2017; Weijzen et al., 2008). Eight studies focused on eating behaviours and habits at lunchtime (e.g., Haugaard et al., 2016; Inoue et al., 2010; Sforzo et al., 2012; Thorsen et al., 2010; VanEpps et al., 2016a, 2016b; Vyth et al., 2011). Eleven studies measured eating behaviours throughout the working day (e.g., Freedman & Rubinstein, 2010; Hartline-Grafton et al., 2010; Hollands et al., 2018; João et al., 2018; Lake et al., 2016; Park et al., 2017b; Payne et al., 2013; Pridgeon & Whitehead, 2013; Vasiljevic et al., 2017; Wang et al., 2014; Zunker et al., 2008) and one study measured behaviours around workplace dinner time (Yoon et al., 2011). For most studies (22 out of 23), eating behaviours were the primary outcome variable. A number of studies covered general eating behaviours at work, and several were qualitative (e.g., Freedman & Rubinstein, 2010; João et al., 2018; Lake et al., 2016; Park et al., 2017b; Payne et al., 2013; Pridgeon & Whitehead, 2013; Zunker et al., 2008).Many studies measured variables related to the workplace canteen, daily energy (kcal) purchased per day (Hollands et al., 2018; Vasiljevic et al., 2017) selection of lower calorie vs higher calorie food choices (VanEpps et al., 2016a, 2016b) fruit and vegetable consumption per customer in a canteen meal (Thorsen et al., 2010), amount of a purchased lunch meal consumed (Haugaard et al., 2016) and number of times healthy meal discount card was utilized (Sforzo et al., 2012). Some outcome variables focused on aspects of snacking, including amount of snacks consumed (Baskin et al., 2016), type of snacks consumed (Sonnentag et al., 2017), or type of snacks selected/purchased (Weijzen et al., 2008). One study focused on the frequency of lunch breaks (Inoue et al., 2010), another study focused on the number of workplace dinner participants attended (Yoon et al., 2011) and another on number of eating occasions during the working day (Hartline-Grafton et al., 2010). One study focused on weight loss as the primary outcome, with support for healthy eating behaviours from colleagues as a secondary variable (Wang et al., 2014).

Sample sizes of reviewed studies ranged from 14 to 24,596. Most studies were conducted in the United States (n = 9) and the United Kingdom (n = 5), with the remaining studies conducted in Denmark (n = 2), Netherlands (n = 2), Germany (n = 1), Japan (n = 1), Korea (n = 1), South Korea (n = 1), and Portugal (n = 1). Out of 23 included studies, five were qualitative studies and 18 were quantitative. Of the 18 quantitative studies, 5 were cross sectional, 5 were longitudinal, 4 were randomized control trials, and 4 experimental designs. In terms of recruitment, nearly all studies utilized self- selected participants. Of the studies that recorded gender (12/23), 9 of these studies had a larger number of females participants com-

pared with males. In terms of study quality, quality ratings ranged between 4 and 9 (quantitative studies M = 6.8, qualitative studies M = 7.1), indicating that they were moderate to high quality. Detailed characteristics for all included studies are presented in appendix 3.

The following section summarizes factors affecting eating at work, which have been categorized into the following categories; job role factors, the workplace food environment, and social factors.

1) Job role factors

The first theme of factors affecting eating at work corresponds to the job role. There are four distinct factors within this category: pressured working environment, opportunity to eat at work, work facilitated meals, and work stress. All studies identified these factors as barriers to healthy eating, being associated with an increased consumption of unhealthy foods.

a) Pressured working environment

In total, in five studies (qualitative studies n=4, quantitative n=1), a pressured working environment was reported as having a negative impact on eating behaviours at work. Four studies reported that employees felt unable to take a lunch break due to the pressure of completing work tasks (e.g., Inoue et al., 2010; Lake et al., 2016; Park et al., 2017b; Pridgeon & Whitehead, 2013). Qualitative interviews with office workers in South Korea described how a demanding environment in the office encouraged employees to work through lunch and frequently eat lunch at their desks (Lake et al., 2016; Park et al., 2017b). Additionally, some employees were found to skip a lunch meal altogether to save time (Park et al., 2017b; Payne et al., 2013). In a qualitative study Lake *et al.* (2016), some employees mentioned that "eating at desk" culture is widespread and likely driven by excessive workload. In addition, some employees went on to say that they eat lunch at their desk so that they do not interrupt their work and can leave the workplace earlier.

b) Opportunity to eat at work

The review found three studies (qualitative n=1, quantitative n=2) that reported on employees' opportunities to eat at work. For example, one study investigated eating patterns of school employees, as there was a concern that the school environment provided staff with limited opportunities to eat (Hartline-Grafton et al., 2010). Contrary to the authors' predictions, the study found that school employees ate very regularly—37% of participants' daily energy intake was from food consumed at work and an average of two eating occasions were reported during the working day. Different results were reported in a qualitative study by Payne *et al.* (2013), who found that some participants believed they ate a lot less during the working day compared with out-of-work hours and attributed their under eating to being too busy at work. Another study found that making time for a lunch break, alongside mindful eating and eating with close colleagues, increased meal satisfaction for employees. Which in turn was associated

with a positive mood, lower levels of stress, and hunger levels after lunch (Haugaard et al., 2016).

c) Work facilitated meals

There were three studies (qualitative n=2, quantitative n=1), which reported on how work arrangements directly influence their eating behaviour. For example, business dinners tend to be perceived as a barrier to healthy eating (e.g., Park et al., 2017b; Payne et al., 2013; Yoon et al., 2011). In some organizations, dinner with colleagues was viewed as a continuation of the working day (e.g., Park et al., 2017b; Payne et al., 2013; Yoon et al., 2011). Generally, workplace dinners were associated with unhealthy meals and less autonomy over food choice (Park et al., 2017b; Payne et al., 2013).

d) Work stress

There were two studies (qualitative n = 1, quantitative n = 1) that reported on the role of workplace stress on eating behaviour at work. Overall, work stress appears to increase unhealthy eating behaviours (Payne et al., 2013; Sonnentag et al., 2017). Sonnentag *et al.* (2017) found that on days when employees experienced more self-control demands at work (e.g., remaining polite when facing a disgruntled customer), they were more likely to eat (consumed greater number of sweets) to regulate their emotions. In contrast, boredom and stress at work was shown to be positively associated with an intake of additional calories at work (Payne et al., 2013).

2. The workplace food environment

The second theme identified in this systematic review corresponds to factors describing the workplace environment. There are four unique factors in this category: availability of healthy vs unhealthy foods in the workplace, food and eating facilities, provision of nutritional information, and cost of healthy options.

a) Availability of healthy vs unhealthy foods in the workplace

In total, six studies reported on availability of healthy vs unhealthy foods in the workplace (qualitative n = 3, quantitative n = 3). The results suggest that access to healthy foods in the workplace is often limited, compared with an abundance of unhealthy foods present in workplace canteens, onsite shops, and vending machines (e.g., Baskin et al., 2016; Freedman & Rubinstein, 2010; João et al., 2018; Payne et al., 2013; Pridgeon & Whitehead, 2013). Four studies reviewed suggest that workers desire a greater variety of healthy and fresh foods compared with the current offering (e.g., Freedman & Rubinstein, 2010; Lake et al., 2016; Payne et al., 2013; Pridgeon & Whitehead, 2013). Interestingly, some employees felt that food served in the canteen had not been adapted to suit the nutritional needs of the present workforce. For instance, employees considered canteen food too high in calories and

regarded it as more suitable for physically demanding roles as opposed to office-based roles (Pridgeon & Whitehead, 2013).

The proximity of food items also influences consumption of calories at work (Baskin et al., 2016; Payne et al., 2013). For example, in an observational study, the authors found that employees who visited a beverage station closer to a snack station were much more likely to consume a snack (Baskin et al., 2016). Although no effect was found between relative proximity and time of day on snacking, a marginal main effect of time of day was found indicating that snacking increased as the working day progressed (Baskin et al., 2016). Interestingly, participants in a qualitative study by Payne et al. (2013) expressed a belief that proximity and time of day combined increased their consumption of unhealthy snacks. Employees said that they were more likely to eat unhealthy snacks in the afternoon to relieve boredom, and an on-site shop increased accessibility of such snacks. Additionally, employees stated they chose unhealthy options in the canteen because they were convenient and otherwise not available at home (e.g., chips) (Payne et al., 2013). Some evidence suggests that employees' body mass index (BMI) might interact with the workplace environment in determining eating behaviours in the workplace. One study reported that in comparison to colleagues with healthy weight, university employees with overweight or obesity had found it harder to make healthy food choices at work and were more easily swayed by the unhealthy foods available at the worksite and in the nearby neighbourhood (Freedman & Rubinstein, 2010).

However, for some, the workplace is viewed as a facilitator for healthy eating. For example, some employees reported that the lunch provided by the work canteen is the only opportunity to have a “proper meal” each day (Payne et al., 2013). Similarly, providing healthy foods (such as vegetables and fruit) increased intake of those foods (Lake et al., 2016; Thorsen et al., 2010). In one such study, participants who were supplied with free fruit during the working day for a total of 18 weeks reported that their consumption of fruits had increased (Lake et al., 2016). What is worrying, however, is that some employees reported they ate free fruit in addition to energy dense snacks such as chocolate (Lake et al., 2016). Existing evidence also suggests that decreasing the availability of unhealthy options and providing meals with increased fruit and vegetables in a workplace canteen led to a sustained increase of consumption of fruit and vegetables over a 5- year period (Thorsen et al., 2010).

b) Food and eating facilities

The importance of food facilities on eating behaviour at work was explored in two studies (qualitative n = 2). Availability of facilities where food can be prepared was considered to be an important facilitator of healthy eating by some employees (Lake et al., 2016; Pridgeon & Whitehead, 2013). For instance, a lack of facilities to heat and store food determined what

employees consumed for lunch—fewer facilities encouraged cheap and convenient, but energy dense foods such as instant packet noodles. Additionally, limited space where food can be consumed was identified as a reason why many employees purchase unhealthy snacks from the workplace canteen and consume these at their desks (Pridgeon & Whitehead, 2013).

c) Provision of nutritional information

The value of providing nutritional information was explored in five studies (quantitative n = 5). In all five studies, information was presented in workplace cafeterias (e.g., VanEpps et al., 2016a, 2016b; Vasiljevic et al., 2017; Vyth et al., 2011) with the objective of encouraging healthy food choices. VanEpps *et al.* (2016b) found that traffic light information was more effective in encouraging employees to purchase food items with fewer calories than detailed information about the exact calorie content. Additionally, VanEpps *et al.* (2016a) found that the optimal combination of factors was for employees to order their lunch in advance (participants placed orders any time after 7 AM and selected a time to pick up any time between 11 AM and 2 PM) and include low calorie labels "under 500" on food products. Contrary to these findings, two studies reported no effects of nutritional labelling on food choices. First, Vyth *et al.* (2011) conducted a randomized control trial and found no difference in food choice when using a "choices" logo to highlight a healthy food choice. Secondly, Vasiljevic et al. (2017) reported that the introduction of calorie labelling had no effect on energy (kcal) purchased across six different worksite cafeterias.

d) Cost of healthy options

In two studies (qualitative n = 1, quantitative n = 1), the cost of food was explored as a possible determinant of healthy eating in an office-based workplace. In one qualitative study, the higher cost of healthy options compared with unhealthy options was identified as one of the most significant barriers to healthy eating (Pridgeon & Whitehead, 2013). One study experimentally reduced the cost of healthy food options by offering 25% discount card for healthy meals in the workplace cafeteria (Sforzo et al., 2012). Despite this, the authors found no increase in healthy meals purchased. In fact, participants rarely used their cards (on average 1.5 times per week). Sforzo et al. (2012) concluded that despite eliminating barriers to healthy eating such as cost and inconvenience, other factors (such as motivation to improve one's eating behaviours) could still prevent healthy eating at work.

3. Social factors

The final theme identified in this systematic review relates to a range of social factors that have been identified as important determinants of eating behaviour in the office-based workplace.

Overall, in nine studies (qualitative n = 4, quantitative n = 5), social influences at work were identified as having influence on various aspects of eating behaviour at work. Seven

studies reviewed suggest that colleagues can have both a positive and negative influence on eating behaviours in the workplace (e.g., Freedman & Rubinstein, 2010; Lake et al., 2016; Park et al., 2017b; Payne et al., 2013; Wang et al., 2014; Yoon et al., 2011; Zunker et al., 2008) Other co-workers who share office space can encourage unhealthy eating behaviours (e.g., Lake et al., 2016; Park et al., 2017b; Payne et al., 2013) but can also be a source of positive cultural and social norms that improve people's choices (e.g., Park et al., 2017b; Payne et al., 2013; Yoon et al., 2011; Zunker et al., 2008).

Two qualitative studies reported that working late often resulted in eating dinner with colleagues (Park et al., 2017b; Payne et al., 2013). In those studies, participants reported feeling pressured to share unhealthy food with colleagues such as pizza (Payne et al., 2013). In one study, celebrations such as birthdays or Christmas were synonymous with a wide availability of cakes, biscuits, and chocolates bought into the office by colleagues (Lake et al., 2016). Employees reported increased consumption of unhealthy snacks in such contexts even when they were actively attempting to reduce their weight. Furthermore, it may be the case that some employees are more influenced by colleagues eating habits than others. In one of the reviewed studies, employees who were overweight or obese were more likely to be influenced by the food choices of friends and colleagues compared with employees with healthy weight (Freedman & Rubinstein, 2010).

Social norms for eating in the workplace may differ from one culture to another another (e.g., Park et al., 2017b; Yoon et al., 2011; Zunker et al., 2008). Indeed, in certain cultures, there is a greater emphasis towards eating together in the workplace with both African American and Korean communities endorsing the importance of eating with colleagues (e.g., Park et al., 2017b; Yoon et al., 2011; Zunker et al., 2008). Yet South Korean office workers reported feeling pressured to participate in workplace meals (lunch and dinners) with colleagues. In particular, older/senior colleagues often ordered food for a group of subordinate colleagues. Some participants reported the desire to control their weight by choosing their own lunch; however, the desire to be part of the working group prevented them from doing so (Park et al., 2017b). In other cases, office workers reported skipping a lunch meal altogether if they were unable to eat with colleagues (Park et al., 2017b).

Colleagues can have a positive influence on eating behaviours (e.g., Haugaard et al., 2016; Lake et al., 2016; Wang et al., 2014). For instance, among other factors eating lunch with close colleagues was found to be an important determinant of the overall meal satisfaction (Haugaard et al., 2016). In turn, greater meal satisfaction was associatedwith a positive mood, lower levels of stress, and hunger levels after lunch. Others who share office space can also facilitate healthy eating in the workplace (Lake et al., 2016; Wang et al., 2014). For example, social support from colleagues for healthy eating was associated with less weight gain in an

intervention designed to prevent weight gain (Wang et al., 2014). However, the study also found that friends' support for healthy eating and family support for physical activity predicted improved weight management; therefore it is difficult to establish which one of these support networks had a greater influence on participants' food choices (Wang et al., 2014).

Lake et al. (2016) conducted interviews with participants in the intervention group of a randomized controlled trial, in which participants were offered free fruit at work for 18 weeks. The authors found that support from colleagues was important in encouraging fruit consumption in the workplace, in particular support from managers. The fruit intervention also appeared to have an impact on office social norms as some participants reported feeling guilty about eating unhealthy foods when consumption of such foods became less widespread (Lake et al., 2016). The intervention also helped to raise important conversations with colleagues regarding BMI and blood pressure, promoting awareness around good health and nutrition. Relatedly, evidence suggests that perceived organizational support is important in promoting a healthy diet at work. Sonnentag et al. (2017) found that employees who considered their organization as supportive of healthy eating were more likely to eat for "health" rather than as a tool to regulate their emotions.

2.6. Discussion

The aim of this review was to examine existing literature and identify factors that have been shown to influence eating behaviour in office-based workplaces. Across 23 unique studies published between the years 2008-2018, most factors affecting office-based eating had a negative influence on eating behaviours. Barriers to healthy eating at work included factors relating to job role (e.g., pressured working environment, work facilitated meals, and workplace stress), the workplace food environment (e.g., limited availability of healthy foods, proximity of unhealthy foods, and facilities to prepare food), and social influences. Among the most prolific facilitators of healthy eating was the supportive role of colleagues in consuming healthy foods (Lake et al., 2016; Wang et al., 2014) and elements of the physical work environment such as increasing availability and reducing cost of healthy food such as free fruit, increasing fruit/vegetables in workplace meals and reducing the number of unhealthy options (Lake et al., 2016; Thorsen et al., 2010). Many factors appear to interact, for example, workplace boredom and availability of chocolate in an onsite shop or working late and social influence on workplace dinner choices (Park et al., 2017b; Payne et al., 2013).

Some of the same factors affecting eating behaviours at work were reported in a systematic review of research on eating behaviours among nurses (Nicholls et al., 2017). Consistent with that review, the present review found that environmental factors (e.g., limited availability of healthy food options and inadequate preparation areas) and colleagues can have both a negative (e.g., Baskin et al., 2016; Park et al., 2017b; Wang et al., 2014) and positive

effect on eating behaviours (Lake et al., 2016; Wang et al., 2014). One of the new insights from the present review is that some office-based workers reported eating less during busy and stressful periods at work (Park et al., 2017b; Payne et al., 2013). This is concerning as undereating at work may have adverse effects on concentration and performance (Adolphus et al., 2013; Parry et al., 2017). Research has shown that skipping meals can lead to increases in perceived appetite and reduced satiety when one or two meals are missed; periods of restriction can result in binge-eating and other disordered eating behaviours among susceptible individuals (e.g., Leidy & Campbell, 2011; Polivy, 1996; Polivy & Herman, 1985). In contrast, reported boredom at work was positively associated with the consumption of eating foods high in sugar and fat (Payne et al., 2013). Given that shift workers are typically more active than office workers, it is possible that office workers have fewer opportunities to compensate for ingestion of excess calories (Church et al., 2011). In summary, it is clear that some of the same broad factors appear to affect eating behaviours of office workers and nurses working in health care environment, although research with employees in sedentary roles identified some unique factors.

This review highlights paucity of existing literature. The focus on different aspects of eating behaviour varied between studies, which makes it particularly difficult to compare their results. Some studies focused on lunch (Haugaard et al., 2016), others on snacking (e.g., Baskin et al., 2016; Lake et al., 2016; Sonnentag et al., 2017), and yet others on eating patterns throughout the working day (e.g., Freedman & Rubinstein, 2010; Hartline-Grafton et al., 2010; João et al., 2018; Park et al., 2017b). Moreover, the current review highlighted heterogeneity in the methods used to measure eating behaviours. Among those used in studies considered in this review, authors relied on self-reports, observational methods, and canteen sales data to analyse purchases. The majority of studies used a variety of self- reported measures of eating behaviours (Freedman & Rubinstein, 2010; Sonnentag et al., 2017). This is concerning as evidence suggests that self-reporting of food intake and body weight may be subject to underreporting (Gosse, 2014; ONS, 2016). Alternative methods of capturing eating behaviours at work included observational methods (Baskin et al., 2016) and analysis of canteen sales figures (Thorsen et al., 2010; Vasiljevic et al., 2017). However, both approaches increase difficulty of assessment of eating behaviour at an individual level (e.g., Baskin et al., 2016; Hollands et al., 2018; Thorsen et al., 2010; Vasiljevic et al., 2017) and canteen sales do not measure actual consumption (Thorsen et al., 2010; Vasiljevic et al., 2017). Furthermore, in some studies, free food was available to employees (e.g., Baskin et al., 2016; Lake et al., 2016; Vasiljevic et al., 2017; Weijzen et al., 2008) which makes both generalizability and comparison of the findings difficult. Evidently, there is a need to develop objective measures of eating in the workplace. Given that self-reports can lead to omission and recall bias, this could be

overcome by collecting self-reported data in real time, by using experiential sampling methods, for example (Sonnentag et al., 2017).

A large number of studies included in this review were cross-sectional and qualitative, which limits the ability to make claims about causal relations (Baskin et al., 2016; Sonnentag et al., 2017). There is an evident lack of high-quality longitudinal research, which could determine the long-term impact of the work environment on eating behaviours (VanEpps et al., 2016a). Another potential issue is that most studies relied on willing volunteers and that a high proportion of participants were female (e.g., Haugaard et al., 2016; Lake et al., 2016; Payne et al., 2013; Pridgeon & Whitehead, 2013; Wang et al., 2014). Self-selected participants may be motivated to lose weight (Haugaard et al., 2016), have a greater interest in their health and/or more time to participate (Fodor et al., 2014) than those who do not respond to requests for participants, affecting the generalisability of studies' results.

Many studies did not consider the broader food environment outside of the workplace (e.g., supermarkets, take away shops). This is important as the availability and proximity of unhealthy foods in nearby neighbourhoods may increase consumption of such foods during the working day. Similarly, office design may influence eating behaviours, as one study found that visibility of food in an open floor plan increased the amount consumed (Rollings & Wells, 2017). Given the growing number of open plan offices, it is unclear if this particular design choice influences eating behaviour of the workforce in a real-world setting.

This review is not without limitations. Many studies did not consider office-based workplaces and a white-collar population as unique features of their designs. Few studies used other populations/environments as a control, and it is therefore difficult to assess the extent to which reported results are in fact specific to the population of office-based workers. Indeed, many studies were excluded from this review merely because they did not provide sufficient information about the workplace context in which the study was conducted.

In summary, the findings of this review highlight the need to understand factors affecting eating behaviours in the workplace in more depth. First, future research should continue to test modifications of the workplace food environment to encourage healthy food choices. Second, research should aim to develop a validated measure of eating behaviour at work. Third, more research is required to explore social influences on eating at work (e.g., Baskin et al., 2016; Lake et al., 2016; Park et al., 2017b; Wang et al., 2014). One recent and promising workplace intervention, vegetable purchases increased after posters displaying a descriptive social norms message were introduced (Thomas et al., 2017). Such an intervention is relatively cheap and easy to implement, and yet it can leverage the power of social norms. More randomized controlled trials and longitudinal research should establish how to best use social norms to improve eating behaviours in the office-based workplaces. Fourth and finally,

work demands may lead to restrictive eating patterns, and more research is required to investigate disordered eating at work and any predictors that can generate or exacerbate disordered eating (e.g., Lake et al., 2016; Park et al., 2017b; Payne et al., 2013).

2.7. Conclusion

This review helps to further understanding of eating behaviours in an office-based workplace. Identifying factors that influence eating at work is a vital step towards a healthier and more productive workplace. The office workplace is a unique microenvironment where people spend most of their time and consume most of their calories. This review demonstrated several factors that can have a positive and negative impact on eating behaviours within office-based workplaces. Interventions based around social and physical aspects of the workplace appear to be most promising, but more research is needed to establish strong causal links.

2.8. Chapter 2 Summary

The following chapter presented the findings of a systematic review, which is a published article in Obesity Reviews (Clohessy et al., 2019). Several factors appear to affect people's eating behaviours at work and most the of evidence suggests that the office-based workplace is associated with unhealthy eating behaviours. Factors that affect eating behaviours of office-based workers include factors relating to the job role and workplace food environment. Notably, a main influence on people's eating behaviours was other people working in the same organisation. This theme will be explored in further detail in the next chapter, by considering the influence colleagues may have on body weight judgements.

Chapter 3: Reference groups, body weight judgements and thesis aims

3.1. Chapter 3 Overview

Firstly, this chapter discusses the implications of the systematic review findings presented in the previous chapter and considers colleagues as an important reference group for body weight judgements. Following this, it considers what is known about who people compare themselves with to make a weight judgement and what is known about reference groups more generally. Next, a summary of theories of how people make body weight judgments and an introduction to rank based judgements. Then, a summary of the key points covered in chapters one, two and three. Finally, an outline of the objectives and aims of the thesis, as well as an overview of the thesis structure.

3.2. Body weight and the workplace

Chapter two presented the findings of the systematic review that investigated factors affecting eating behaviours in the office-based workplace. As discussed in the review, colleagues appear to be a key influence on the eating behaviours of people they work with. Most studies within the review suggested that colleagues have mostly a negative impact on eating behaviours of others they work with. Therefore, it is evident that social norms relating to eating behaviours in the workplace influence *what* food is consumed (e.g., cakes) and *how* people eat (e.g., eating lunch alone at the desk) (Lake et al., 2016; Park et al., 2017b). Given the influence that colleagues appear to have on other people's eating behaviours, it is plausible to assume they also have the potential to influence people's objective weight (BMI). However, arguably a more interesting question is whether colleagues influence the way that people *perceive* their weight (e.g., underweight, healthy weight, overweight, obese, severely obese). The systematic review findings suggest that people make social comparisons with colleagues about eating behaviours. Research also suggests that social comparisons occur on a dimension related to eating behaviours, body weight (e.g., Polivy, 2017; Robinson & Kersbergen, 2017). Therefore, it is possible that people may use their colleagues as a comparison group of which to judge their weight against.

In summary, given the amount of time spent with colleagues in the workplace, they could be used as an important reference group when comparing one's body weight with others. However, it is not clear which reference group people use when making body weight judgements. A key range of reference groups may influence how people perceive their weight, although it is unclear if one reference group exerts a greater influence on people's judgements. The next section below will consider research that has identified reference groups that are important for informing people's body weight judgements.

3.3. Reference groups and body weight judgements

Research studies have identified traditional sources of media (e.g., magazines, television) as a source of comparison for appearance (e.g., Becker, 2004; Grabe et al., 2008; Groesz et al., 2002). In more recent years, social media platforms have been identified as a source comparison for body weight which typically display idealised images (Fardouly et al., 2017; Holland & Tiggemann, 2016). For example, a study exposed participants to 20 minutes on Facebook or other websites (Mabe et al., 2014). They reported that women exposed to the Facebook condition showed greater concern towards their shape and weight compared to participants in alternative conditions (Mabe et al., 2014). Furthermore, a study found that individuals who follow fitness content on Pinterest were more likely to report intentions to engage in extreme weight-loss behaviours. It was suggested this result was due to upward social comparisons with idealised images (Lewallen & Behm-Morawitz, 2016).

On the other hand, research has identified key reference groups that people with overweight or obesity compare their weight with, and as a result underestimate their weight (i.e., believe they are a 'healthy' weight). For example, friends have been cited as an important reference group when making weight status judgements. Studies have shown that healthy (i.e. healthy BMI range) weight adolescents who identified incorrectly as overweight were more likely to have friends with larger sized bodies than those belonging to a slimmer friendship networks (Ramirez & Milan, 2016). Furthermore, research suggests that people living in the same neighbourhood may provide a source of comparison and consequently affect how people perceive their weight. Research studies have found that underestimation of the weight status of others with overweight or obesity is more likely to occur in geographical areas where obesity is more common (Binkin et al., 2013; Robinson & Hogenkamp, 2015).

3.4. What do we know about reference groups generally?

The sections above have discussed reference groups in relation to eating behaviours and weight judgements. Although, this thesis is primarily focused on eating behaviours and weight judgements, it is important to consider what is known about reference groups in the broader literature.

Social judgement studies are often concerned with the influence of other people on people's beliefs and judgements on a given topic. A common approach in social judgement studies is to ask people questions about one specific reference group (e.g., fellow students) (Aldrovandi et al., 2015b). Some studies have found that to make a judgement, people are likely to compare themselves with individuals in their social circles and/or individuals with similar demographics such as age and gender (Quintana-Domeque & Wohlfart, 2016; Ramirez & Milan, 2016). On the other hand, research has asked participants questions about people living in the same area as them, it is believed people living close by may be an important target for comparisons (e.g., Blanchflower & Oswald, 2004; Quintana-Domeque & Wohlfart, 2016).

Finally, it is common for researchers to ask participants about their beliefs about the general population (Galesic et al., 2018a). A limitation of these studies is that they ask participants about a pre-specified group. By only asking participants questions about one group, researchers assume that people use this group to make a judgement. However, the composition of reference groups appears to be less commonly investigated. It is this fundamental research question that forms the focus of some of the studies presented in this thesis.

3.5. How do people make body weight judgements?

The previous sections have considered the influence of other people on body weight judgements. However, it is important to understand *how* people make weight judgements, the section below will discuss various explanations of how people make body weight judgements.

a) Social comparisons

One explanation for how people make weight judgements is via social comparisons. Festinger (1954) proposed that it is necessary for people to compare themselves with others to make an accurate self-evaluation. People may engage in social comparisons to determine their performance (in any domain) relative to others and these comparisons can be either upward or downward (Galesic et al., 2018a). Research suggests that people use upward and downward social comparisons to evaluate their body weight with others, e.g., do I weigh more or less than my colleagues?) (e.g., Fitzsimmons-Craft, 2017; Rancourt et al., 2015). People who make comparisons with someone in a position they consider to be less advantageous is known as a *'downward comparison'*, e.g., perceiving you weigh less than the comparison target. This type of comparison can be associated with increased self-esteem (Polivy & Pliner, 2015). On the other hand, people who make comparisons with someone they perceive to be in a better position than themselves is known as an *'upward comparison'*, e.g., perceiving you weigh more than the comparison target. This type of comparison can be associated with decreased self-esteem when the same level of performance cannot be achieved (Polivy & Pliner, 2015). Social comparisons can affect weight related thoughts and behaviours. For example, research has found that upwards comparisons were associated with diet and weight control behaviours (Polivy & Pliner, 2015). A study found that females engaging in upward comparisons (e.g., where the comparison target was deemed a lower weight than themselves) were more likely to diet and engage in other weight control behaviours (Rancourt et al., 2015). However, this was not the case for downward comparisons, which were associated with increased risk of weight gain. Based on the research discussed above, it is evident that judgements about weight are relative. For example, people compare themselves with other people in order to make judgements about their weight (e.g.,Fitzsimmons-Craft, 2017; Robinson & Kersbergen, 2017). Research on social comparisons have centred on the subjects similarity or difference with others and the consequences of this for self-esteem (Polivy & Pliner, 2015). However,

research on social comparisons does not explain what actually happens when the comparison is taking place. In other words, how exactly do people *make* these judgements? What are the cognitive mechanisms behind *how* people make a body weight judgement? The sections below will consider two broad theories in explaining the cognitive mechanisms that may underpin how people make body weight judgements; reference level theories and rank-based theories. Both classes of theories have been applied to judgements in a number of different domains.

b) Reference level theories

Reference level theories is a concept widely adopted in social psychology. Reference level theories propose that people compare themselves to the mean of stimuli in each context i.e., people use one single reference point to make a judgement (Clark & Oswald, 1996). Galesic et al. (2018b) observed that participants are often asked to evaluate themselves relative to an average person. Furthermore, research on social norm-based interventions tend to give participants information on how their behaviour compares with an average, with the aim to change people's behaviour in line with the average person. For example, in order to try to reduce energy consumption, Schultz, Nolan, Cialdini, Goldstein, and Griskevicius (2007) provided households with information about the amount of energy consumed by their household and the average amount of energy consumed by households in the neighbourhood. However, providing this descriptive message to households produced differing effects; people with high energy consumption were more likely to decrease their energy consumption use. On the other hand, households with low energy consumption were more likely to increase their energy consumption as a result of the information about how their behaviour compares to the mean.

Previous research studies have used reference level theories as an explanation for why people with overweight and obesity are more likely to underestimate their weight status (e.g., Robinson, 2017; Robinson & Kersbergen, 2017; Robinson & Hogenkamp, 2015). Weight underestimation has also been observed when people judge the weight of others. Parents of children with overweight and obesity have been found to underestimate their children's weight (e.g., Jones et al., 2011; Lundahl et al., 2014). Similarly, research has found that medical professionals visually underestimate patients with overweight and obesity (e.g., Ahern et al., 2012; Robinson et al., 2014). Research has accounted for these weight misperceptions by suggesting that people evaluate their weight status using an 'internal average' of what they perceive a normal body weight represents (e.g., Robinson & Kersbergen, 2017). According to the *visual normalisation theory*, whether a particular person is judged as overweight or not depends largely on the distance between the target and an 'internal' average (e.g., Robinson, 2017). A second component of the *visual normalisation theory* suggests that exposure to larger bodies in society has shifted perceptions of what represents a 'normal' body weight upwards. As a result, this shift has caused some people with overweight or obesity to underestimate

their weight, and instead believe they are of 'average' size (e.g., Robinson & Kersbergen, 2017). However, rank based theories have addressed limitations of reference level theories and will be discussed in the section below.

c) Rank

Another explanation for how people make weight judgements is *rank* with others, and it is this concept that is central to the studies presented in this thesis. Rank models propose that people's subjective judgments of a given quantity reflect its rank within a given context of comparable stimuli (e.g., Aldrovandi et al., 2015b). Rank theories differ to reference level theories as they suggest that evaluations are influenced by all other stimuli rather just a single reference point (e.g., mean). Research in other fields suggests that people are sensitive to their ranked position with others, this effect has been shown in numerous studies (e.g., Boyce et al., 2010; Melrose et al., 2013; Wood et al., 2011). Extensive research studies suggest that people use rank to make judgements, it forms part of theories and models of social judgements such as including Range Frequency Theory (RFT) and Decision by Sampling (DbS) (Parducci, 1965; Stewart et al., 2006). Parducci (1965) coined the Range Frequency theory and proposed that when making a judgement people are influenced by whole distribution of a sample of items, instead of the mean of a sample (as reference level theories suggest). Range Frequency Theory can be applied to weight judgements. In this context, what matters is not the mean of comparison weights but a) how an individual weight compares to the smallest and largest amounts in a comparison context (the range principle) and b) where the particular weight amount ranks within the context (the rank principle). This effect has been shown in a number of studies including context effects in judgements of body image (Wedell et al., 2005), emotion (Russell & Fehr, 1987), wages (Brown et al., 2008), personality (Wood et al., 2012)and educational satisfaction (Brown et al., 2015).

The Decision by Sampling model extends earlier rank-based models such as Range Frequency Theory. Relative rank is a key component of Decision by Sampling theory (DbS) which suggests that a subjective value of a stimulus is based on a series of binary, ordinal comparisons in a sample e.g., a target item is compared to every other item in a sample (binary) and then judged to be either smaller or larger than that comparator (ordinal). The Decision by Sampling model provides an explanation for the cognitive mechanisms behind *how* people make a judgement but also places importance on the role of samples drawn from long-term memory in forming a context of comparison. However, the studies within this thesis did not aim to test the predictions of DbS against those of RFT and therefore the section below will refer to rank-based models in a more general sense. In the context of social judgments, a vast number of research studies have reported that people are sensitive to the relative ranked position within a comparison group, and this is true over and above an absolute quantity (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Maltby et al., 2012; Melrose et al., 2013).

For example, people's satisfaction of income has been found to be influenced by where their wage ranks with a social comparison group rather than their absolute income (Boyce et al., 2010). Furthermore, rank effects have even been explored in health topics such as judgements of drunkenness whilst intoxicated, perceived health benefits of exercise and tooth brushing duration (e.g., Maltby et al., 2016; Maltby et al., 2012; Moore et al., 2016). Furthermore, rank-based explanations of judgments have been compared with the predictions of mean-based models of judgment. A rank-based explanation has been shown to better account for how context influences people's judgments across numerous domains including; depression and anxiety symptoms, alcohol consumption, personality, health benefits of exercise and food healthiness (e.g., Aldrovandi et al., 2015a; Maltby et al., 2012; Melrose et al., 2013; Wood et al., 2011; Wood et al., 2012). In the literature investigating body weight judgements, the reference level account still predominates i.e., people compare themselves to an average body weight in order to make a judgement about their own weight (Robinson & Kersbergen, 2017). In this thesis, we will test whether people use rank relative with others (over and above their objective weight) to make a body weight judgement. For example, we propose that to make a weight status judgement (e.g., 'I believe I am overweight'), people mentally calculate where their weight ranks relative to others. They do so by comparing their perceived weight, with every other item in their mental sample and determining whether their weight is smaller or larger than the comparator. Depending on the distributional properties of the sample in context, the same stimuli may be judged differently depending on its rank position i.e., the same body size may seem smaller or larger if the comparison context changes. In this thesis, we are also interested in exploring who people compare themselves with when ranking themselves with others i.e., the reference group. This is important because a limitation of previous studies investigating rank is that they often ask participants about their beliefs towards one reference group, which inhibits understanding of who people sample when ranking themselves with others (e.g., Galesic et al., 2018a; Putnam-Farr & Morewedge, 2019). One way to understand about people's beliefs towards the social norm is to elicit people's beliefs about the distribution of a behaviour. Indeed, several studies have elicited people's beliefs about social norms distributions (e.g., student indebtedness) (Aldrovandi et al., 2015b). A distribution can be defined as a frequency of a given behaviour in a specific reference group (e.g., UK population). Unlike summary statistics such as the mean of a sample, the distribution can inform us about the prevalence of a behaviour at different levels (e.g., the top 1% of people in the UK earn 175, 000 per year). Rank based theories (e.g., *Decision by Sampling*) propose that people evaluate their position by ranking themselves within a distribution and use their perceptions of where they rank within the sample to make a judgement. This is important as it may lead to biased judgements, if people base their rank position on a small or unrepresentative sample. Therefore, when people make a judgement, depending on the

distributional properties of the context, the same stimuli may be judged differently depending on its rank position. For example, the same body size may seem smaller or larger if the comparison context changes. In the context of body weight, if someone has a high BMI score, but they are among others with even higher BMI scores, they may rank themselves in the lower section of the sample and perceive their weight to be smaller than it objectively is. Given there is evidence that people use rank to inform judgements across many different contexts, it is reasonable to believe that rank can explain *how* people make judgements towards body weight. This thesis will examine if people use rank when making judgements towards body weight, as well as exploring reference group composition when people rank their weight with others. This thesis will also examine if people use perceived rank of their eating behaviours among different reference groups to inform judgements about their own eating behaviours (e.g., level of worry restrained eating) (Chapter 7).

3.6. Summary of chapters one, two and three

The following section will provide a brief overview of the findings and research areas covered in chapters one, two and three alongside rationale for the thesis aim and objectives. Social norms are implicit rules set by other people and reference groups are fundamental to whether social norms are followed (Bicchieri & Dimant, 2019; Legros & Cislaghi, 2020). Research suggests that perceptions of social norms (commonly incorrect) often guide people's behaviours and judgements (e.g., Kuang et al., 2020; Wood et al., 2011). Furthermore, research suggests that people use others as a guide for eating behaviours (Higgs, 2015; Prinsen et al., 2013). Indeed, the systematic review presented in chapter two found that colleagues were influential on eating behaviours in the workplace and a source of social norms (Clohessy et al., 2019). Given that colleagues influence others eating behaviours at work, it is possible that people compare their weight to colleagues to make a weight judgement (e.g., I am overweight), however this is currently unclear. This led to a broader research question regarding who people include in their reference group when comparing their weight with others. It is also unclear how people make body judgements, i.e., the cognitive mechanisms behind these judgements. Previous research has proposed that people make weight judgements using a single reference point for example the average of a sample (Robinson, 2017). For example, someone might compare their own weight to what they perceive is an average weight within the UK population (Robinson & Kersbergen, 2017). However, research across several domains suggests that people use rank to make judgements (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Maltby et al., 2012; Melrose et al., 2013; Quispe-Torreblanca et al.). This thesis will test whether people use rank to make a weight judgement and explore reference group composition (in relation to weight judgements) (studies 1-5). Furthermore, research studies suggest that social media is a source of social norms in relation to eating behaviours. This thesis will also explore how restrained eating is perceived in two key

reference groups and whether perceptions (often incorrect) of the social norms relating to restrained eating affect people's judgements towards their own eating behaviours. Additionally, another source of social norms may be online media articles, this will be explored in study 8.

3.7. Thesis aims and objectives

Aim

- This thesis aimed to understand perceptions of social norms and reference groups in relation to eating behaviours and weight judgements.

Objectives

Chapter Five

1. To test whether rank of body weight with other people influences several subjective weight related judgments (e.g., weight status) and examine rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population) **(study 1)**
2. To explore the composition of reference groups when people rank their body weight with that of others **(study 2)**
3. To understand further who participants compare themselves with when ranking their body weight with others by eliciting a distribution of two key reference groups (UK population and friends/family) **(study 3)**

Chapter Six

4. To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight* (scale 1 'very underweight' to 5 'very overweight') of male 3D figures **(study 4)**
5. To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight status* (e.g., overweight) of male 3D figures **(study 5)**

Chapter Seven

6. To test a rank-based approach as an underlying mechanism to explain people's *judgements* towards their restrained eating **(study 6)**
7. To test a rank-based approach as an underlying mechanism to explain people's perceived *worry* towards their restrained eating **(study 7)**

An outline of the thesis structure is presented in the section below, alongside details of each study.

3.8. Thesis Structure

The thesis comprises of eight chapters, six of which present study findings; systematic review (chapter one), studies 1-3 (chapter five), studies 4-5 (chapter six), studies 6-7 (chapter seven), There are eight studies in total.

Chapter four describes the methodology and rationale for the methodology used in the studies. Further detail for methods used in each study will be expanded on in the individual chapters.

Chapter five presents three studies which examine whether people use rank to inform body weight judgements. The studies also explore who people include in their reference group when ranking their weight with other people.

Chapter six presents studies 4 and 5 which build upon the findings of chapter five. The studies investigate whether people's judgments reflect sensitivity to the mean of a comparison context or whether people are sensitive to the rank position of a judged stimuli among other stimuli in a comparison context. In study 4, participants were asked to judge the weight of 3D figures which varied in waist size (1 'very underweight' to 5 'very overweight'). In study 5, the same methods are replicated as study 4, except here participants judged the weight status (e.g., obese) of the figures.

Chapter seven examines participants beliefs about the social distribution of disordered eating (e.g., restrained eating) in two reference groups (females in the UK population and females participants follow on Instagram). Studies 6 and 7 utilised a rank-based approach as an underlying mechanism to explain people's judgements towards their restrained eating.

Chapter eight provides an overview of all the study findings. Followed by a discussion of the theoretical and practical implications of the study findings. Then, strengths and limitations of the studies are discussed, followed by suggestions for future research. The chapter ends with a conclusion.

3.9. Chapter 3 Summary

Firstly, this chapter discussed the implications of the systematic review findings and considered colleagues as an important reference group for body weight judgements. Following this, it explained what is known about who people compare themselves with to make a weight judgement and what is known about reference groups more generally. Next, a summary of theories of *how* people make body weight judgments and an introduction to rank based judgements were presented. Followed by a summary of the key points covered in chapters one, two and three. Finally, an outline of the objectives and aims of the thesis, as well as an overview of the thesis structure.

Chapter 4: Methodology

4.1. Chapter 4 Overview

This chapter provides an overview and background to the methods utilised in this thesis. First, an overview of study design, participant recruitment, and participant characteristics included within each of the studies are presented (studies 1-7). Then, a description of the research methods used within the thesis and discussion of the rationale for the methods used in each study and finally a chapter summary.

4.2. Study Design

Nearly all studies (studies 1-7 presented in chapters 5, 6 and 7) collected quantitative data using online questionnaires.

Studies 1-7 were uploaded onto an online survey platform Qualtrics (https://www.qualtrics.com/uk/). For studies 1-7, all participants were shown instructions before they took part in the online study and informed consent was obtained. Any participants who did not give their consent were re-directed to the end of the questionnaire and were not able to complete the questionnaire. At the end of the study, all participants were shown a debriefing sheet which stated the aim of the study, contact information, and several resources on healthy eating and/or help for disordered eating. A benefit of Qualtrics is that it enables users to employ different question types. The studies reported in this thesis utilised a wide range of question options on Qualtrics such as slider scales and multiple-choice options.

4.3. Participant Recruitment

This section will detail how participants were recruited to take part in the online studies. The recruitment plan for each study was detailed in the University of Warwick ethics form and full ethical approval was obtained from Biomedical and Scientific Research Ethics Committee (BSREC) before collecting any data. This section will first describe how participants were recruited for study 1. It should be noted that the recruitment plan changed during study 1, reasons for which will be explained below. In Study 1, the study was uploaded onto an online survey platform Qualtrics (https://www.qualtrics.com/uk/). Initially, opportunistic sampling was used. The Qualtrics study link was disseminated by emailing the study link to people the first author had connections to (e.g., colleagues, friends), these individuals were then asked to forward the study link to people who might fit the eligibility criteria for the study (office workers, aged over 18, living in the UK, not currently a student). However, this method of recruitment was not as efficient anticipated. Therefore, the recruitment plan was amended in the ethics form to also include the online participant sourcing platform Prolific Academic (https://www.prolific.co/). Prolific was used as the method of recruitment for studies 1-7

within this thesis; studies 1-3 (chapter five), studies 4-5 (chapter six), studies 6-7 (chapter seven). Prolific is perceived to be an advantageous recruitment platform over other alternative platforms (e.g., MTurk). For example Prolific enables researchers to screen for participants on range of dimensions before inviting them to take part in a study (Palan & Schitter, 2018). For studies 1-7, participants recruited via Prolific were paid a pre-specified amount for taking part in each study. Participants were informed of the payment amount, estimated length of time the study would take to complete and supplied with a brief description of what the study entailed before consenting to participate. The monetary compensation amounts for each study are outlined in each chapter. Using Prolific enabled fast recruitment of large numbers of participants in the studies included in this thesis. Once participants were recruited via Prolific, eligible participants accessed the questionnaire via the online survey platform Qualtrics (as mentioned above).

4.4. Participant Characteristics

Studies 1, 2, 3, 4 and 5

As previously mentioned, the initial aim for the thesis was to investigate eating behaviours in the workplace. After conducting a systematic review (described in chapter 2), the first study in the thesis aimed to explore the weight judgements of office-based workers. Therefore, study 1 used a sample of full-time office workers. However, as the fundamental research questions explored in the thesis broadened (i.e., *how* do people make weight judgements?), it was no longer essential to only include office workers in the participant sample, it was important that the findings could apply to human behaviour and judgements in the broadest sense. Collecting data simply using office workers would potentially limit the generalisability of my findings. Therefore, in the remaining studies (studies 2, 3, 4 and 5) participants were included from a wider section of society, the thesis no longer focused solely on the judgements of just office workers. For studies (studies 1, 2, 3, 4 and 5), a feature on Prolific called a pre-screener was used to recruit participants that met the desired inclusion criteria for each study. A pre-screener filters Prolific users who meet a specified criteria and only these participants have the option to access the survey link and complete the survey. Using this feature, I was able to ensure that only participants who were over 18, living in the UK and not currently a student could participate in studies 2-5 (an additional inclusion criteria was used for study 1- full-time office workers). Furthermore, following on from study 1 a further pre-screener criteria was applied to ensure that participants who had completed any previous studies could not take part in any of the future studies on Prolific. This was because the topics surveyed were similar in nature and it increased the risk of biased results. A feature was used on Prolific to ensure that participants who had taken part in previous studies could not take part in any subsequent

studies. This was achieved by using a pre-screener questionnaire so that before participants could take part in the actual study they needed to meet certain requirements. The following screener feature on Prolific was applied 'exclude participants from previous studies' to ensure that participants could not take part in multiple similar studies.

Studies 6 and 7

The focus of chapter seven was to investigate females' beliefs of restrained eating in different reference groups a) females whom participants follow on Instagram and b) females in the UK population. Research suggests that social media use is associated with higher rates of restrained eating, therefore an interesting topic area would be to explore how restrained eating was perceived on Instagram (Fardouly et al., 2017). The same eligibility criteria used for studies 1-5 (e.g., aged 18 and over, living in the UK and not a student) was applied to studies 6-7. However, studies 6-7 focused on assessing perceptions of females towards restrained eating and therefore an additional inclusion criterion was applied to the studies that only female participants were able to take part. For studies 6-7, only participants with an Instagram account and no previous history of disordered eating behaviours could participate. However, the specific questions were not available as a pre-populated option on Prolific. Therefore, custom pre-screening questionnaire was created on Prolific, which asked Prolific users two questions "*Are you currently receiving, or have previously received, psychological and / or medical treatment for an eating disorder or other related condition?"* (Yes, no, I'd prefer not to say) and *"Do you have an Instagram account?"* (Yes, no). Participants were paid a pre-specified amount for taking part in this pre-screener questionnaire. Only participants without a history of disordered eating and participants with an Instagram account were able to access and complete the main study. It was vital participants had an Instagram account because the survey asked about their beliefs about other females they follow on Instagram. All participants were debriefed after taking part and due to the sensitive nature of the questions in the pre-screener questionnaire, participants were provided with links to resources for help with disordered eating such as signposting to the eating disorders charity BEAT.

4.5. How do studies typically measure weight judgements?

A main objective of this thesis was to explore *how* people make weight judgements and *who* they make weight judgements with. This particularly relates to studies 1-3 (chapter five) which explores the cognitive mechanisms behind *how* people make body weight judgements and reference composition. However, it is first important to consider how previous studies have measured weight judgements. Typically, researchers ask participants to make a judgement towards their own weight. One way to do this is by asking participants to judge their own weight status. Weight status refers to descriptive categories that are typically defined by BMI,

they are used by the NHS, e.g., 'Healthy weight' represents a BMI range of 18.5 - 24.9 (Health Survey for England, 2019). Often studies investigate the discrepancy between a person's weight status and their objective BMI weight (although it should be noted this was not the focus of any of the studies included in the thesis). Research has reported that people with overweight or obesity often underestimate their weight, and instead identify themselves in the healthy range or 'about right' (e.g., Robinson & Kersbergen, 2017; Robinson & Oldham, 2016; Yaemsiri et al., 2011). Typically, underestimation of weight status is defined as at least one category above the participants actual weight status. In contrast overestimation of weight status is defined as at least one category below the participants actual weight status (Lang et al., 2019).

Additionally, research studies ask participants to make a judgement towards the weight of *other* people. For example, studies have asked parents to judge the weight status of their children with overweight or obesity and medical professionals to judge the weight status of patients (e.g., Jones et al., 2011; Lundahl et al., 2014). Another method that studies employ is to ask participants to rate the weight of 3D models, where typically the 3D figures represent different weight status and BMI scores (Oldham & Robinson, 2017). Some studies that have investigated weight judgements have proposed that people compare themselves against an internal norm or 'prototype' of what is perceived as being the average size (e.g., Oldham & Robinson, 2017; Robinson & Kersbergen, 2017). However, research across domains suggest that to make a subjective judgement, people rely on their perceived rank of a behaviour in a reference group. The studies in this thesis measured rank.

4.6. Rank based methods: weight and eating behaviours

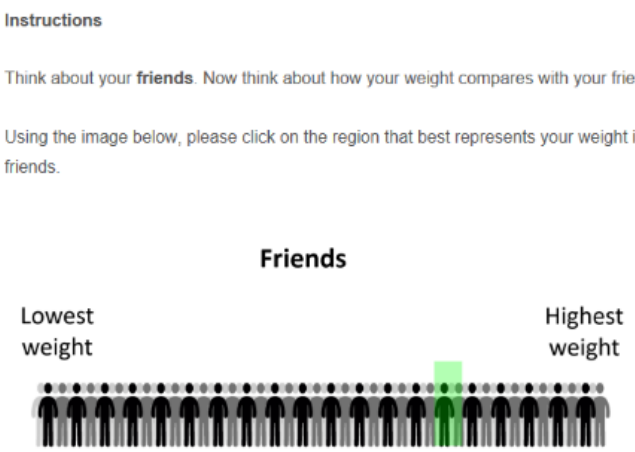
This thesis focused on rank-based methods because extensive research studies across domains suggest that people rely on rank to make a judgment (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Boyce et al., 2010; Maltby et al., 2012; Melrose et al., 2013; Moore et al., 2016; Wood et al., 2011). It was deemed important to explore whether people use rank to make a weight judgement and who people compare themselves with when making this judgement. Rank methods will be discussed for studies 1-7. Studies 1-5 explored rank in relation to weight judgements, whereas studies 6-7 explored rank in relation to judgements about eating behaviours. The following section will detail the methodology used in each study (studies 1-7). The section will also explain the typical methods used to measure rank-based judgements, and where appropriate explain the rationale for introducing new methodology to measure rank-based judgements relating to body weight and eating behaviours.

Study 1

The primary aim of study 1 was to test whether rank of body weight with other people influences several subjective weight related judgments (e.g., weight status). Study 1 also examined rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population). The results of the systematic review (discussed earlier in chapter 2) suggested that colleagues are influential on people's eating behaviours in the office workplace. Based on this finding, an interesting area to explore was if people compare their body weight with their colleagues to make a body weight judgement. Originally, the focus on study 1 was to ask participants to *'rank'* their weight with people working in the same organisation as participants to ascertain if they used this information to make a body weight judgement (e.g., weight status). However, the aims of this study broadened and instead in study 1 participants were asked to rank their body weight with three other reference groups (people who live in your neighbourhood, friends, UK population). By doing this, study 1 explored if one reference group was more important over others for informing weight judgements. Based on previous research, three other reference groups were identified that people might use to make a body weight judgement (people who live in your neighbourhood, friends, UK population) (e.g., Blanchflower & Oswald, 2004; Quintana-Domeque & Wohlfart, 2016; Ramirez & Milan, 2016)**.**

In study 1, participants perceived rank among others was measured. This measure was inspired by a task that has been used to assess participants perceived rank in a sample such as Achtypi et al. (2021). For example, in the study by Achtypi et al. (2021) participants were shown an image of a horizontal line of water bottles (labelled from 'least expensive' to 'most expensive'), here participants were asked to estimate the price of a water bottle indicated by a vertical red line on the image. In study 1, participants were explicitly asked to rank their weight with others (often rank studies use an implicit method to establish perceived rank in a reference group, these methods used in study 3 and study 6-7 are discussed later in this section). Similar to Achtypi et al. (2021), participants were shown a horizontal line of figures (representing other people) (see figure 2 below). Participants were asked to assess their rank of body weight with these figures (ranging from 'lowest weight' on left hand side to 'highest weight' on the right-hand side) participants completed a separate question for each of the four reference groups. Previous studies that have tested rank effects often ask participants questions about a pre-specified reference group e.g., fellow students (Aldrovandi et al., 2015b). Therefore, asking participants to rank themselves with several groups is a novel contribution.

Figure 2 *Question shown to participants to elicit rank of body weight among others*



Study 2

The aim of study 2 was two-fold. Firstly, to replicate and confirm the findings from study 1, that people did utilise perceived rank amongst other people to make a weight judgement. Secondly, study 2 aimed to explore who people compared themselves to when ranking their weight with 'other people'. This built upon the findings of study 1, which asked participants to rank their weight with prescribed reference groups. Study 2 asked participants to rank their weight with 'others'. The methods used in study 2 were inspired by methods used in previous studies in social judgement and decision making such as that by Kim et al. (2018). In an online survey, Kim et al. (2018) first asked participants to think of one individual with whom they usually compare themselves in terms of their financial circumstances. Participants were asked "*Who is the first person that comes to mind? This individual can be anyone you like*", participants were then asked to enter the initials of the person they identified (e.g., LO) in a text box. Next, these initials were then appeared in the question on the next page using piped text on Qualtrics software, where several questions were asked about the individual (e.g., LO). In your own view, how dissimilar or similar are you to this individual?") using an 11-point slider scale. In study 2, participants were asked to rank their weight with 'others'. Piped text refers to a question function on Qualtrics software. Piped text is a line of code that researchers can add to surveys. Piped text pulls information from different sources and displays that information to the participant, ensuring the answer choice is customizable for the participant. For example, in this study, after asking participants for initials of people they compared their weight with, the piped text function pulled their selected answers into a follow up question and displayed in the question text. A novel method was then used to

explore who these 'others' were by asking participants to provide a set of initials of people they had thought of when ranking their weight. Participants were then asked several questions about the set of initials (e.g., point of reference for each initial i.e., friend, family member, colleague etc). An advantage of using Qualtrics, is that it allows the initials to be 'piped' into a question on another page of the survey. As a result, we could ask participants questions relating to the specific initials they had provided. This method is novel as typically studies exploring social judgements and rank ask participants to compare themselves with pre-specified groups (Aldrovandi et al., 2015b; Wood et al., 2011). Further details about the methodology and procedure are provided in chapter five.

Study 3

Study 3 was interested in how people perceive the weight of others in two reference groups a) UK population and b) friends/family. One method used to understand people's beliefs about social norms is to elicit distributions of a given behaviour referred to as the 'distribution elicitation' method (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Melrose et al., 2013). A distribution can be defined as a frequency of a given behaviour in a specific reference group (e.g., UK population). Unlike summary statistics such as the mean of a sample, the distribution can inform us about the prevalence at different levels of a given behaviour. (e.g., the top 1% of people in the UK earn 175, 000 per year). People utilise the distribution to form views about the social norm and in turn people often use their beliefs about the social norm to make a judgement. However, often people's judgements are incorrect as a direct result of misperceived norms (Melrose et al., 2013).

The methodology used in study 3 was based on a distribution elicitation task used in previous studies to examine whether people use rank within a sample to make a judgement (e.g., Maltby et al., 2012; Melrose et al., 2013; Wood et al., 2011). This method asks participants about their own behaviour on a topic as well as their beliefs about how other people behave i.e., participants consumption of chocolate bars as well as their beliefs about other people's consumption of chocolate bars. Aldrovandi et al. (2015a) asked participants (students) how many chocolate bars they consume per week. Participants were then asked 11 questions eliciting what they believe to be the distribution of chocolate bar consumption among other students. Questions are often as follows; "The highest consuming *x*% of students eat more than ___ bars of chocolate per week", where *x* typically takes values of 10, 20, 30, 40, 50, 60, 70, 80, 90 and participants are asked to fill in the blank. Participants answers are used to estimate each participant's normal cumulative distribution function of their beliefs (e.g., chocolate bars consumption among other students). From this, the relative ranked position of a participant (in this instance self-reported number of chocolate bars consumed) within their

elicited distribution can be calculated (referred to as 'inferred rank'). Research has found that it is the inferred rank that predicts people's judgements, rather than the mean of sample (e.g., Aldrovandi et al., 2015b; Maltby et al., 2016; Melrose et al., 2013). Calculating a participant's inferred rank has advantages over asking people *'where do you rank'* (like study 1). Researchers have proposed the latter method may lead to self enhancement bias (i.e., people perceive themselves more favourably) (Wood et al., 2011).

Study 3: New methodology for eliciting a social distribution

Study 3 elicited participants beliefs about the distribution of body weights in two key reference groups; a) friends/family and b) UK population. Participants were asked to estimate the weight and height of people in two reference groups, a)friends/family b) UK population. To elicit these distributions, a similar method to Achtypi et al. (2021) was used, which asked participants to provide a distribution of stores prices for a product. In this study, participants were presented with 10 equally spaced bins spanning from low to high prices. For each bin, participants had to indicate how many out of 100 stores they expected the product would be sold for by allocating 'tokens' to price ranges. In study 3, instead of using tokens to elicit a social distribution, the slider question type was used on Qualtrics (see figure 3 below). This was important as asking participants to estimate other people's weights could be challenging, therefore a simple method was selected. Participants were asked to judge the perceived weights (kg) of their friends/family and the UK population rather than BMI. Estimating the weight and height of other people may have been challenging for some participants. However, estimating the objective weight of reference group members was considered a more feasible alternative compared to asking participants to judge other people's BMI scores. This is because it is unlikely people would be able to accurately predict BMI scores of themselves or BMI scores of other people (e.g., estimate that someone has a BMI of 22) without giving participants information about BMI categories (e.g., BMI score under 18.5 is classed as underweight) and offering this information this may have biased the results. This is important because the study was primarily interested in people's perceptions towards their own weight and the weight of others. Therefore, asking participants to report their perceptions of the weight (kg) of other people (even if they were not entirely accurate) appeared to be the most viable option.

Figure 3 *Question to elicit perceived distribution of weights in friends and family*

Studies 4 and 5

The objectives of studies four and five (chapter six) were to test whether people are sensitive to the rank position of a judged stimulus among other similar stimuli in a comparison context or whether people use the mean of the sample to make a judgement. Previous studies have investigated rank sensitivity and context effects. A typical method is as follows, in a study by Aldrovandi et al. (2015b) participants were shown 11 quantities of student debt and were asked to rate their level of concern with each debt amount (assuming it was theirs). Participants were allocated to different distributions of debt amounts; unimodal (most waist sizes are near the middle of the distribution) or bimodal (most waist sizes are in the smallest or largest third). Both distributions shared the same mean, but target debts differed in how they ranked among other debts in the comparison sample. The mean ratings of concern were compared across common debt amounts in each distribution. If participants utilised the mean, all the common debt amounts should be rated the same regardless of the distribution. However, participants held differing levels of concerns for the common debt amounts, demonstrating that they relied on rank for their judgments rather than the distance from the mean. The next section below will outline the methods utilised in studies 4 and 5 based on the methodology just described.

Studies 4 and 5: New methodology for testing sensitivity to rank using 3D models

Studies 4 and 5 aimed to test rank sensitivity for weight judgements. One way to test this effect could be to use a similar method to Aldrovandi et al. (2015b) (as described above). For example, participants could be shown either sample a): 65kg, 75kg, 85kg or sample b): 45kg, 55kg, 65kg. In this example, participants could be asked to judge the weight status of each

weight amount. 65kg ranks lower in sample a) and higher in sample b), therefore one would expect that 65kg might be judged differently depending on where it ranks within each distribution. However, this approach does not consider that participants have no context of individuals heights and therefore no understanding of how someone's absolute weight (e.g., 65kg) might appear visually (i.e., fat distribution). Therefore, asking participants to judge weights displayed in numeric form lacks ecological validity. In studies 4 and 5, participants judged the weight of 3D models representing different waist sizes and BMI scores. Previous studies have asked participants to judge the weight or weight status of 3D models representing different weights (e.g., Oldham & Robinson, 2017; Thaler et al., 2018). However, no research has directly examined if people utilise the rank of a sample to inform weight judgements or if people utilise the average of weights within a sample. For studies 4 and 5, four different styles of 3D figures from four different sources were considered. Firstly, Oldham and Robinson (2017) utilised a validated scale of 3D models representing different weights and based on real life BMI scores created by Harris et al. (2008). An example of their methodology is as follows, Oldham and Robinson (2017) presented participants 3D figures with either healthy or obese BMI scores. Participants were then shown 3D figures representing a wide range of BMI scores and asked to select the body weights they perceived as 'normal'. Next participants estimated the weight status of an overweight male or female figure. Participants exposed to the obese figures were more likely to underestimate the weight status of the overweight figure, as a result this shifted the range of body sizes perceived as 'normal' upwards. Here, the researchers propose that people rely on an internal average of what they perceive to be a normal body to make judgement. For the purpose of studies 4 and 5, the models created by Harris et al. (2008) could not be utilised as there were not enough figures. As an alternative, 3D figures were created for studies 4 and 5. To ensure ecological validity of the figures it was important to calculate the BMI and then the weight status of each of the 3D models. A 3D visualiser by a software called 'Daz' was considered as a possible software (see https://www.daz3d.com/). However, it was not possible to calculate the objective BMI scores of the figures using this program. Another BMI visualiser considered was created by Max Planck Institute, however it wasn't possible to manipulate the waist size of the figures (see https://bmijs.is.tuebingen.mpg.de/). A second program by Max Planck Institute was used to create the 3D models https://bodyvisualizer.com/, the models were created using the average height of males in the UK to control for height and manipulated the waist size of each figure as well as calculating BMI scores which were all based on real life measurements. Further details of this methodology can be found in chapter six.

Studies 6 and 7

Studies 6 and 7 investigated participants beliefs about restrained eating in two key reference groups (females on Instagram and females in the UK population). It appears few researchers have investigated perceived norms of restrained eating neither have researchers investigated restrained eating in relation to Instagram. This study utilised the social elicitation task for eliciting distributions of a behaviour as described above for study 3 and used by Aldrovandi et al. (2015b) however investigated a new area; disordered eating behaviours. A similar method was used to Melrose et al. (2013) who asked participants about their own levels of anxiety and depression and participants beliefs about anxiety and depression in the general population. Melrose et al. (2013) study found that judgements about an individual's own levels of anxiety and depression are not based on frequency of their own symptoms, but by where participants ranked the severity of their symptoms in comparison with their believed symptoms of others (Melrose et al., 2013). Like study 1 and 3 (chapter five) studies 6 and 7 used the UK population as a one reference group to compare beliefs to other reference groups, in this instance Instagram.

Ethical approval

All studies were approved by the Biomedical and Scientific Research Ethics Committee (BSREC), University of Warwick. Studies 1-3 (approval BSREC REGO-2018-2326), studies 4-5 (approval BSREC REGO-39/20-21) and studies 6-7 (approval BSREC REGO2019-2326).

4.7. Chapter 4 Summary

Chapter four introduced the study design, outlined the participant recruitment strategy, and detailed the participant characteristics included in the studies within this thesis. It also provided rationale for the methods used alongside justification for novel methodology. In the next chapter, the findings of studies 1, 2 and 3 will be presented.

Chapter 5: Rank and reference groups for body weight judgements

5.1. Chapter 5 Overview

This chapter reports on the findings of studies 1, 2 and 3, which begins with aims and objectives for chapter five. Then, the context of the three studies will be discussed in relation to the findings of the systematic review (chapter two). Next, the abstract and an introduction for studies 1, 2 and 3 is provided. Following this, the findings of studies 1, 2 and 3 are presented. Then, a general discussion of all three studies which compares the findings to existing literature, considers the implications of the findings and limitations of the studies, followed by a chapter summary.

5.2. Aims

- To test whether rank of body weight with other people influences several subjective weight related judgments (e.g., weight status) and examine rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population) **(study 1)**
- To explore the composition of reference groups when people rank their body weight with that of others **(study 2)**
- To understand further who participants compare themselves with when ranking their body weight with others by eliciting a distribution of two key reference groups (UK population and friends/family) **(study 3)**

5.3. Abstract (Studies 1, 2 and 3)

Evidence across domains suggests that people compare themselves to others and rank is used to inform a subjective judgment. Social judgement studies often prescribe the reference group (e.g., students), what is less clear is the composition of the reference group when ranking oneself with others. Three studies found that where people perceive their weight ranks relative to others influences subjective judgements (e.g., weight status) and explored the composition of the reference group when ranking body weight with others. In study 1, participants ranked their weight with prescribed reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population). Participant's rank of weight among friends was the most important reference group when making weight status judgements. UK population was the most important group for the remaining outcome variables. In study 2, participants ranked their weight with *'others'* and explored the reference group composition for body weight. Participants were most likely to include friends, followed by family of the same gender in their reference group. Study 3

elicited participants beliefs about the weights in two distributions 1) friends and family 2) UK population. It appears that participants sample a mix of the UK population and friends/family when ranking their weight with others and use this to make body weight related judgements. This paper extends previous literature by applying relative rank to body weight judgements and more broadly examining relative rank with different populations and exploring the composition of the reference group, of which can be applied to any domain.

5.4. Introduction

Social norms are commonly known as the unwritten rules shared by society or members of the same group (Legros & Cislaghi, 2020). The reference group is an important component of social norms. This refers to relevant others whose actions or beliefs one takes into account when deciding what to do and whose behaviour and (dis)approval matter in sustaining the norm (Bicchieri & Dimant, 2019). These relevant others may change depending on the social norm in question.

Perceptions of social norms matter for subjective judgements (Bicchieri & Dimant, 2019). Evidence suggests that people often rely on their perception of the social norm when making judgments about body weight or eating behaviours (e.g., Higgs, 2015; Higgs & Thomas, 2016; Robinson & Kersbergen, 2017). In other words, people use the weight or body size of others to make a judgement about their own weight. Researchers commonly assess perceptions of body weight by asking participants to judge their own weight status, e.g., assessment of whether one is 'underweight', 'healthy weight', 'overweight' or 'obese' (e.g., Maximova et al., 2008; Robinson & Kersbergen, 2017; Zhu et al., 2011). However, studies have reported that individuals perceived weight status versus their objective weight status (typically defined by BMI) may differ. For example, research has reported that people with overweight or obesity often underestimate their weight, and instead identify themselves in the healthy range or 'about right' (e.g., Robinson & Kersbergen, 2017; Robinson & Oldham, 2016; Yaemsiri et al., 2011). It is possible that misperceptions about the social norms of other people's weights may lead to incorrect weight judgements. For example, when making a weight judgement, recalling a small or unrepresentative sample of other people may lead to biased estimates about the social distribution of weights in a reference group. For example, imagine person A and person B both weigh 60kg, however they believe they rank differently because of their biased perception of the wider population. If social norms guide individuals' perceptions towards their own weight, we must understand how these are formed. This is important because individuals' judgements towards their own body weight can have important implications for weight-related intentions, attitudes, and behaviours (e.g., Cornelissen et al., 2016; Sonneville et al., 2016; Vartanian & Germeroth, 2011). Some studies report that

accurate identification of overweight is associated with greater weight loss intentions and attempted weight loss behaviours (such as portion size awareness and increased physical activity (e.g., Haynes et al., 2018; Johnson et al., 2014b). What remains unclear is exactly how people make judgements about their body weight and despite their importance, very little is known about the exact cognitive processes by which people engage in social comparison.

Some research has focused on models of relative judgement in the health domain. For example, relative judgements have been used to explain how people make judgements about their body weight. Based on the social comparison theory, research has reported that individuals use upward and downward social comparisons to evaluate their body weight with others (e.g., Fitzsimmons-Craft, 2017; Rancourt et al., 2015). Engaging in said comparisons can affect weight related thoughts and behaviours. Research has reported that females engaging in upward comparisons (e.g., where the comparison target was deemed a lower weight than themselves) were more likely to diet and engage in other weight control behaviours. Whereas females making downwards comparisons (e.g., where the comparison target was deemed to weigh more than the participant) were less likely to engage in weight control behaviours and increased risk of weight gain (Rancourt et al., 2015). Alternatively, visual normalisation theory proposes that individuals make judgements about their body weight by comparing themselves with an internal representation of what they perceive to be the average body weight or size (Robinson, 2017). Visual normalisation theory proposes that the average body weight i.e., 'norm' has shifted upwards in society. Consequently, this had lead people with overweight or obesity to underestimate their weight and instead believe they are of average size (e.g., Robinson & Kersbergen, 2017). Researchers have recently made a suggestion that *rank* could play a critical role to explain how people form judgements about body weight (Robinson & Kersbergen, 2017). Despite this, there has been no direct examination of rank and body weight judgements despite hundreds of studies demonstrating rank effects (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Boyce et al., 2010).

Several models maintain that people can access summary statistics about the decision-making context and use that to infer the value of a judged stimuli. Reference level accounts suggest that judgments of a stimulus depend on a single reference point or 'the average' and that individuals constantly alter their adaptation level when encountering new information (Clark & Oswald, 1996). Research in other fields suggests that people are sensitive to their *ranked* position with others, this effect has been shown in numerous studies (e.g., Boyce et al., 2010; Melrose et al., 2013; Wood et al., 2011). Relative rank is a key component of the *Decision by Sampling theory* (DbS) which suggests that a subjective value of a stimulus is based on a series of binary, ordinal comparisons in a sample. In the context of social judgments,

several studies have reported that people are sensitive to the relative ranked position within a comparison group, and this is true over and above an absolute quantity. For example, people's satisfaction of income has been found to be influenced by where their wage ranks with a social comparison group rather than their absolute income (Boyce et al., 2010). It is believed that the same cognitive mechanisms are used to make judgements across different contexts.

Rank effects have even been explored in health topics such as judgements of drunkenness whilst intoxicated, perceived health benefits of exercise and tooth brushing duration (e.g., Maltby et al., 2016; Maltby et al., 2012; Moore et al., 2016). Aldrovandi et al. (2015a) found that concern about food intake (e.g., chocolate bars) was driven by individuals' beliefs about where their own consumption ranks among others, not the mean consumption of chocolate bars.

Given there is evidence for rank effects across many different judgements, it is reasonable to believe that rank can explain how people make judgements towards their body weight (e.g., Aldrovandi et al., 2015b; Maltby et al., 2012; Wood et al., 2011). As discussed earlier, an integral element of social norms is the reference group (Bicchieri & Dimant, 2019). Social judgement studies often ask participants to compare themselves against the average, or in the context of rank, studies have typically focused on one population for example participants rank themselves on a dimension in relation to other students (e.g., Aldrovandi et al., 2015a; Moore et al., 2016). However, it has been suggested that providing participants with a specific reference group (e.g., 'other students') inhibits our understanding of who people sample when making a judgement (e.g., Galesic et al., 2018a; Putnam-Farr & Morewedge, 2019). In general terms, people living in the same geographical area and people with similar demographics have been highlighted as important reference groups (e.g., Blanchflower & Oswald, 2004; Quintana-Domeque & Wohlfart, 2016). Specific to body weight judgements, previous research has identified peers and friends as an important reference group (e.g., Fitzsimmons-Craft, 2017; Ramirez & Milan, 2016; Rancourt et al., 2015). In the context of rank, it is currently unknown which groups of people individuals' sample when making body weight judgements (for example, do people primarily utilise friends or another group?).

In summary, evidence suggests that individuals use the weight of others to make judgements about their own body weight (e.g., Robinson & Kersbergen, 2017). This is important as it can lead to incorrect weight judgements and consequently impact an individual's attitudes and health behaviours (e.g., Rancourt et al., 2015). Previous research has proposed several different accounts of relative judgments to explain how people make body weight judgements (Fitzsimmons-Craft, 2017). It has been suggested that perceived relative

rank of weight with others in the general population could play a critical role in judgements about body weight, however, relative rank has not been tested in this domain (Robinson & Kersbergen, 2017). Therefore, the aim of study 1 was to test whether rank of body weight with other people influences several subjective weight related judgments (e.g., weight status) and examine rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population). Study 2 aimed to build upon results for study 1 and explore the composition of reference groups when ranking body weight with others. Study 3 aimed to understand further who participants compare themselves with when ranking their body weight with others by eliciting a distribution of two key reference groups.

5.5. Study 1 Introduction

We conducted a systematic review that suggested that colleagues influence eating behaviours in an office based work environment (Clohessy et al., 2019). Based on this result, colleagues may be an important reference group when making a body weight judgement. Study 1 used a sample of office workers to understand whether people working in their organisation were an important reference group for weight judgements compared to other references groups e.g., friends. The main premise of study 1 was to explore whether rank with different reference groups predicts subjective weight related judgements (such as weight status, motivation to lose weight, motivation to gain weight, motivation to maintain weight, motivation to engage in physical activity, perceived risk of diseases associated with underweight, perceived risk of diseases associated with overweight). The aforementioned subjective judgements were chosen as outcome variables because people's judgements towards their own weight have been shown to have important implications for weight-related intentions, attitudes, and behaviours. Indeed, research suggests that accurate identification of overweight is associated with greater weight loss motivations and attempted weight loss behaviours (such as increased physical activity) (e.g., Haynes et al., 2018; Johnson et al., 2014a). Depending on the reference group in which people rank their weight, people may come to different conclusions about their relative position and as a result make incorrect judgements about their weight. For example, an individual with overweight might not be motivated to lose weight if they rank themselves lower in a sample of other people with obesity and as result may not believe they need to lose weight compared to that particular reference group. Furthermore, people with a low or high BMI are at greater risk of developing weight related diseases in the long-term (e.g., Astbury et al., 2019; Nyberg et al., 2018; Park et al., 2017a; Simon et al., 2006). Therefore, mis-estimations of weight relative to others may contribute towards inaccurate judgements of how likely they are to develop a weight related disease in the future. In summary, it is unclear if

people use their perceived rank of body weight with other people in order to make subjective judgements and indeed which reference group is the most salient (e.g., friends, people working in the same organisation, UK population, people living in your neighbourhood).

It was hypothesised that individuals' (often-incorrect) beliefs about their ranked position of body weight will predict judgements towards participants own weight status, perceived risk of disease associated with overweight, perceived risk of disease associated with underweight, motivation to gain weight, motivation to maintain weight, motivation to lose weight and motivation to engage in physical activity.

5.6. Study 1 Methods

Participants

Data from 352 participants (n = 239 females, n = 113 males) aged between 18 - 68 years (M = 34.44, SD = 9.24) was analysed after they completed an online study concerning their body weight perceptions. The mean self-reported weight of participants was 77.30kg (females; M = 72.0kg, SD = 18.4, range = 40-182kg, males; M = 88.7, SD = 30.4, range = 57 - 250kg). The mean body mass index (BMI) of participants was 26.66, SD = 7.33 (females; M = 26.3, SD = 6.5, males; M =27.7, SD = 8.9) of which n = 13 (3.7%) were underweight, n = 179 (50.9%) healthy weight, n = 91 (25.9%) overweight, n = 47 obese (13.4%) and n = 22 (6.3%) severely obese, BMI scores were classified using NHS weight categories (Health Survey for England, 2019) (for participant characteristics see table 1 below and table 2 below for Means and standard deviations for four rank measures and all outcome measures).

Participants were office-based workers, recruited from a range of different workplaces. Two methods of recruitment were utilised. Initial recruitment of participants was opportunistic, an electronic link to the study was distributed via email. Participants accessed the survey via Qualtrics (https://www.qualtrics.com/uk/). To be eligible for the study, participants needed to meet the following criteria; over 18 years old, not currently a student[1], living in the UK and work full time in an office environment. An adult population was chosen as this study was interested in how people working in an office environment perceive their weight to others (typically people working in this environment will be over 18). Furthermore, previous research investigating weight perceptions have often focused on an adult population (e.g., Robinson & Kersbergen, 2017; Robinson & Oldham, 2016). Therefore, to compare results

[1] *Participants were eligible to take part in the study if they were over 18 years of age but not currently a student. If participants did not make the inclusion criteria they were re-directed to the end of the survey. The initial screening questions did not specify students as university students, instead asked "Are you currently a student" Yes, No) due to the fact that most students over 18 years of age in the UK are a University student Bolton, P. (2022). Higher education student numbers*

https://researchbriefings.files.parliament.uk/documents/CBP-7857/CBP-7857.pdf

with previous findings and present an alternative cognitive mechanism by which people make body weight judgements, it was important to keep the same characteristics as these studies i.e., adults. Additionally, participants needed to be living in the UK as they were asked to judge their weight with the UK population and therefore by living in the UK participants would have formed their own perception of people's weight in the UK.

A total of 212 participants completed the questionnaire, 62 responses were removed due to incomplete answers and 151 responses were included in the data analysis.

Further participants were recruited using an online recruitment platform, Prolific (https://www.prolific.co/). An initial screener question was used to ensure all participants worked full time in an office environment, living in the UK, were not students and were over the age of 18. Participants who met the above criteria were then able to complete the online survey (*n* = 209) and paid £1.42 baseline compensation (mean average completion time corresponding to an equivalent of £7.75 per hour). Seven participants were removed due to incomplete answers leaving a total of (*n* = 202).

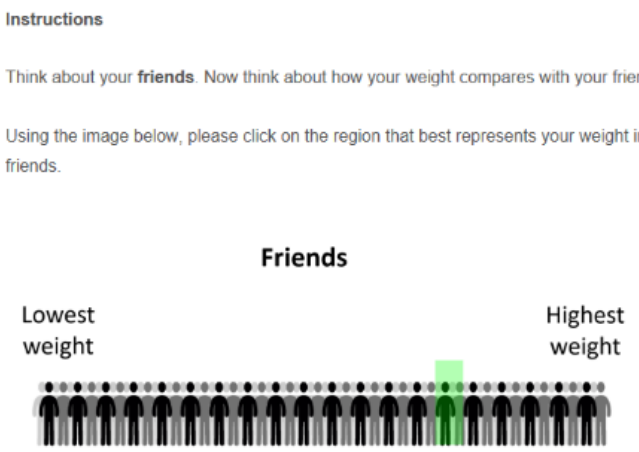
352 participants were included in the main analysis, Qualtrics only recruitment (*n* = 151) and Prolific recruitment (*n* = 201). This research was approved by the University of Warwick's Biomedical and Scientific Research Ethics Sub-Committee (approval BSREC REGO-2018-2326). The main ethical consideration for this project was that comparing one's weight with others might be a sensitive topic for some participants. This might be particularly the case for participants who engage in disordered eating and/or have negative feelings towards their body weight/body image. To mitigate this, this study was piloted with research team members to ensure appropriate language was used throughout the survey. Furthermore, participants were asked to read an information sheet before taking part in the study, which clearly set out what the study would entail. Only after reading this were participants able to decide if they wanted to consent to take part in the study. After taking part, participants were presented with a debriefing sheet. This sheet repeated the objectives of the study, as well as information about what would happen to their data after the study and how it would be stored. Importantly, participants were told that if they had concerns about their eating behaviours or weight to contact their GP and/or access websites such as BEAT (a charity for disordered eating).

Measures

Body weight ranking. Participants answered four questions in a randomised order about how their body weight ranked in relation to different populations (people who live in your neighbourhood, people working at your organisation, friends, UK population). Participants were presented with the following instructions, *'Think about your friends. Now*

think about how your weight compares with your friends. Using the image below, please click on the region that best represents your weight in relation to your (friends)'. Participants selected one out of a total of 20 regions, the region participants selected was represented by a green rectangle on the graphic (see figure 4).

Figure 4 *Question shown to participants to elicit rank of their own body weight among others*



Perceived risk of disease associated with body weight. To measure perceived risk associated with overweight, using a similar method to Moore et al. (2016), participants were asked, '*What do you think the risk is that you will acquire a disease associated with being overweight (e.g., diabetes) in the next 15 years?'* scored from one [very low risk] to seven [very high risk].

Weight motivations. Participants rated their motivation to lose weight *'How motivated are you towards losing weight?* scored 1 [not motivated] to 7 [very motivated]?'

Physical activity. Participants rated their motivation to engage in physical activity, *'Generally, how motivated are you to engage in physical activity?'* scored from 1 [not motivated] to 7 [very motivated].

Weight status. Using a similar method to Johnson et al. (2014b), to measure perceived weight status, participants were asked, *'How would you describe your weight as?'* scored from 1 [very underweight] to 7 [very overweight].

Objective weight measurement. To calculate BMI, participants provided self-reported weight (either using kilograms or stone and pounds) and height (either using cm or feet and inches).

Demographic information. Participants answered a series of demographic questions (gender, age, ethnicity, highest level of education, job category).

5.7. Study 1 Results

Table 1 *Table of participant characteristics study 1*

Number of participants	*N* = 352
Age (years, SD)	18-68, (*M* = 34.44, *SD* = 9.24)
Self-reported weight	40kg-250kg (*M* = 77.30, *SD* = 24.39)
BMI	16.63-73.05 (*M* = 26.66, *SD* = 7.33)
Gender	Female (67.7%), male (32%), 0.3% (other)
Ethnicity (% white)	75.4% (White-English/Welsh/Scottish/Northern Irish/British)
Highest level of education (mean, SD)	49% undergraduate degree
Job category	Higher managerial, administrative, and professional (11.9%). Intermediate managerial, administrative, and professional (41.6%). Supervisory, clerical, and junior managerial, administrative, and professional (46.5%).

Table 2 *Means and standard deviations for four rank measures and all outcome measures*

Measure	Mean (SD)
Rank measures	
Neighbourhood rank	9.76 (3.96)
Colleague rank	10.41 (5.53)
Friends rank	11.07 (4.65)
Population rank	9.36 (3.69)
Outcome measures	
Risk of diseases associated with overweight	2.88 (1.78)
Motivation to lose weight	4.24 (1.60)
Motivation to engage in physical activity	4.60 (1.85)
Weight status	4.43 (1.05)

Data Analysis

A series of correlation analyses (Pearson's r) were undertaken for all rank variables to demonstrate that the rank measures are not perfectly correlated and distinct from one another.

Table 3 *Pearson (r) correlation matrix between participants rank of weight with four reference groups*

	Neighbour rank	Colleague rank	Friends rank	UK Population rank
Neighbour rank	X	.76**	.71**	.82**

Colleague rank	X	.73**	.72**
Friends rank		X	.69**
UK Population rank			X

** Correlation is significant at the 0.01 level (2-tailed).

A series of correlation analyses (Pearson's r) were undertaken for all outcome variables to demonstrate that the outcome variables are unique and should not be aggregated (see table 4 below).

Table 4 *Pearson (r) correlation matrix between outcome variables and BMI*

	Overweight risk	Motivation lose	Motivation PA	Weight status	BMI
Overweight risk	X	.257**	-.280**	.656**	.509**
Motivations lose		X	.297**	.254**	.145**
Motivation PA			X	-.260**	-.233**
Weight status				X	.583**
BMI					X

** Correlation is significant at the 0.01 level (2-tailed).

A series of linear multiple regressions were used to examine whether the four rank measures of weight (people who live in your neighbourhood, people working at your organisation, friends, UK population) predicted a number of outcome variables; weight status, perceived risk associated with overweight, motivation to lose weight, motivation to engage in physical activity. For each outcome variable two models were carried out, one with BMI only (model A) and a second with the addition of four rank measures included (model B). All models include age and gender as covariates. Previous research suggests that demographic variables such as age and gender are associated with people's perception of their weight (e.g., weight status) (Johnson-Taylor et al., 2008; Yaemsiri et al., 2011). Therefore, it is possible that if age and gender are not controlled for they may act as confounders. For further information see table 5.

Weight Status. Model A shows that BMI (with age and gender as covariates) significantly predicted weight status ($p < .01$). Model B sees the addition of the four ranking scenarios of body weight (people who live in your neighbourhood, people working at your organisation, friends, UK population), the variables significantly predicted perceived personal weight status ($p < .001$), the addition of rank measures significantly increased R^2 from .37 to .67. Age, BMI, gender, and rank of weight relative to three of the four reference groups (people who live in your neighbourhood, people working at your organisation and friends) significantly predicted personal weight status ($p < .01$) and interestingly, rank with friends explained the most variance. This result suggests that to make a judgement about their weight status individuals use information about where their weight ranks with others, specifically their friends, alongside their own BMI scores.

Risk of diseases associated with overweight. In model A, BMI (with age and gender as covariates) significantly predicted participants perceived risk of diseases associated with overweight ($p < .001$). Model B significantly predicted perceived risk of diseases associated with overweight ($p < .001$). However, only participants rank of body weight with the UK population was a significant predictor ($p < .01$). Again, these findings are consistent with the rank hypothesis, showing that individuals are concerned about where they rank their weight with the UK population over and above an absolute measure (BMI).

Motivation to lose weight. In model A**,** BMI (with age and gender as covariates) significantly predicted risk of disease associated with overweight ($p < .006$). The addition of the four ranking scenarios of body weight (people who live in your neighbourhood, people working at your organisation, friends, UK population) in model B significantly predicted motivation to lose weight ($p < .001$), however only UK population rank was a significant predictor ($p < .04$).

Again, this suggests that individuals are concerned about where they rank with the UK population over and above an absolute measure of BMI.

Motivation to engage in physical activity. In model A, BMI (with age and gender as covariates) significantly predicted motivation to engage in physical activity ($p < .001$). The addition of the four ranking scenarios of body weight (people who live in your neighbourhood, people working at your organisation, friends, UK population) in model B significantly predicted participants' motivation to engage in physical activity ($p < .001$), however only BMI was a significant predictor ($p < .02$).

Table 5 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, perceived rank of weight with x4 reference groups) towards outcome variables (weight status, overweight risk, motivation to lose weight, motivation to engage in physical activity)*

		Weight status			Overweight risk			Motivation to lose weight			Motivation to engage in physical activity		
		Adj.R^2	β	*p*	Adj.R^2	β	*p*	Adj.R^2	β	*p*	Adj.R^2	β	*p*
Model A	Age	.37	.10	.02	.27	.09	.06	.03	-.06	.23	.05	-.04	.41
	BMI (self-reported)		.59	.01		.51	.01		.16	.01		-.23	.01
	Gender		.16	.01		.09	.06		.10	.06		-.06	.28
Model B	Age	.67	.08	.02	.41	.06	.18	.08	-.07	.16	.05	-.03	.55
	BMI (self-reported)		.25	.01		.25	.01		.01	.88		-.16	.01
	Gender		.10	.01		.06	.18		.08	.14		-.04	.41
	Neighbourhood rank		.19	.01		.09	.26		.04	.68		-.04	.69
	Organisation rank		.14	.02		.11	.12		-.03	.71		-.09	.31
	Friends rank		.24	.01		-.02	.75		.10	.24		.02	.78
	UK Population rank		.11	.07		.31	.01		.20	.04		-.03	.72

Note. All models control for age and gender; β = standardized regression coefficient.

5.8. Study 1 Discussion

Replicating dozens of prior studies across various domains, study 1 demonstrated that rank relative to others influences subjective judgements (e.g., Boyce et al., 2010; Maltby et al., 2012; Melrose et al., 2013). In the context of body weight judgements, the results suggest that participants use relative rank of weight with others to make judgements alongside their BMI. Participants' rank of body weight with friends was the most important reference group for weight status judgements. Previous research has indicated that friends are a salient source of weight-based comparisons (e.g., Fitzsimmons-Craft, 2017; Rancourt et al., 2015). However, for most of the outcome variables, rank of weight with the UK population was the most important reference group. One explanation for this finding is that individuals care about the distributional properties of the weights within the broader population, something that is captured by rank but not BMI. Alternatively, the UK population as a reference group may be too broad, previous research suggests when sampling the general population, individuals may utilise readily available groups such as friends, family, and acquaintances (Galesic et al., 2012, 2018a). Indeed, it is likely when making social comparisons and judgements in real life scenarios, individuals use a combination of people from different social groups, rather than engage in separate judgements based on separate populations as per study 1 (Galesic et al., 2018a). To address this, study 2 aimed to explore the composition of a reference group when ranking body weight with others (e.g., do people sample more friends over colleagues or people with a smaller or larger BMI than themselves?).

5.9. Study 2 Methods

Study 2 offered an opportunity to clarify the results of study 1 by using a different method of eliciting participant's perceived rank of weight. Firstly, participants were asked to rank their body weight with 'other' people rather than pre-defined populations. Secondly, participants were then asked to provide further information about the *'other'* people they had compared their weight with. Data was also collected on an unrelated domain, personality (participants were asked to rank their level of extraversion with others) and the composition of this reference group was explored to act as a comparison group with the body weight reference group. One of the aims of study 2 was to explore the composition of a reference group when people ranked their body weight with others. However, by asking participants similar questions about an alternative reference group on something seemingly unrelated (e.g., personality) we could compare and contrast the composition of the weight reference to the personality reference group. For example, it might be that female participants are more

likely to include other females in their weight reference group but include a greater proportion of males in their personality group, this is not clear at present.

In this pre-registered study, it was hypothesised that individuals (often-incorrect) beliefs about their ranked position of body weight will predict their weight status and perceived risk of disease associated with overweight. Two outcome variables were selected from study 1, perceived risk of disease associated with overweight and weight status, as these two variables led to a significant increase in R^2 with the addition of rank. Questions regarding the composition of reference groups were exploratory and therefore specific hypotheses were not required.

Participants

A total of 139 participants were recruited to complete a study via the online recruitment platform Prolific. To be eligible for the study, participants needed be over 18 years old, work full time, not a current university student and live in the United Kingdom. Eligible participants accessed the questionnaire via an online survey platform Qualtrics.

139 participants (*n* = 56 males, *n* = 83 females) aged between 18 - 63 years (*M* = 31 years, *SD* = 6.1) were included in the data analysis. 77.7% identified as White-English/Welsh/Scottish/Northern Irish/British). The mean body mass index (BMI) of participants was 27 (*SD* = 6.1) and ranged from 17 - 47.9. The mean BMI for female participants was 27.9 (*SD* = 6.8) and ranged from 17 - 47.9 and for males the mean BMI was 25.9 (*SD* = 4.9) ranging from 19.8 - 45.9). Overall, 1.7% (*n* = 2) were underweight, 46.7% (*n* = 56), healthy weight, 25% (*n* = 30) overweight, 23.3% (*n* = 28), obese and 3.3% (*n* = 4) severely obese. The average self-reported BMI was 27.1, this sample is comparable to the national average given the average BMI is 27.7 in the UK (Health Survey for England, 2019).

Design and procedure

Body weight ranking. A similar measure was utilised to study 1, however participants were asked about their perceived rank of weight among <u>others</u>, '*Think about how your body weight compares with other people. Using the image below, please click on the region that best represents your own weight in relation to others'.* Participants selected one out of a total of 20 regions, the region participants selected was represented by a green rectangle on the graphic.

Weight reference group. Participants were then asked to provide initials of the *'other'* people (minimum of 5, maximum of 10) with whom they had compared their weight with into a text box (e.g., LO). All sets of initials from the previous question were 'piped' into the next question using Qualtrics online survey software (e.g., LO, AM, BC) for a similar approach see Kim et al. (2018). Participants were then asked to arrange the sets of initials in order of weight (low to high). For each set of initials, participants were asked to assign a category, selecting

from pre-defined options (e.g., friend, family member, colleague, social media personality, neighbour, celebrity, other- for which a free text box was provided). For each set of initials, participants also provided age, gender, level of extraversion and estimated height and weight (in their preferred metric) (for instructions see figures 5-7).

Figure 5 *Question eliciting sets of initials participants used when ranking their weight*

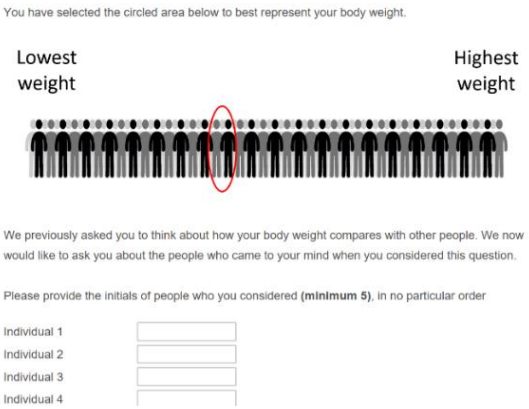


Figure 6 *Question eliciting order of sets of initials in relation to weight*

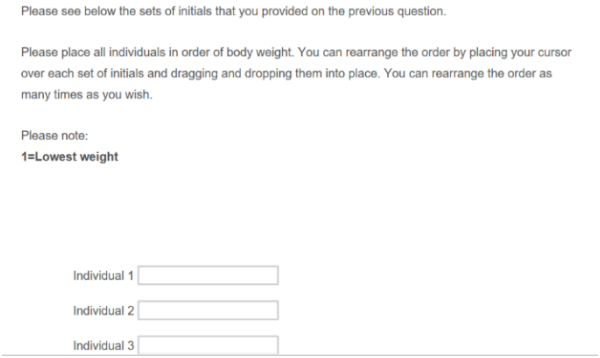
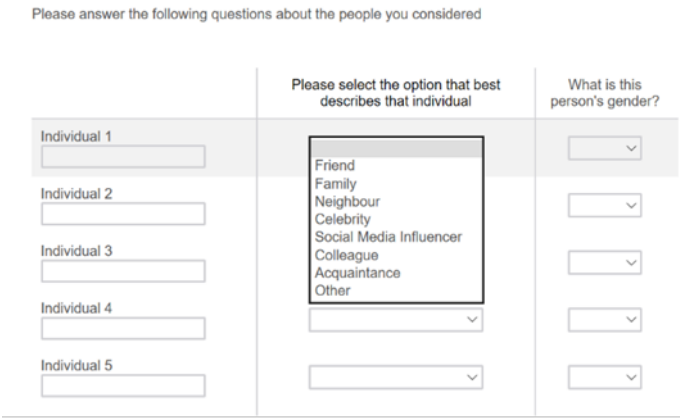


Figure 7 *Question eliciting category of each set of initials*



Personality reference group. Participants were asked to rank their level of extraversion with other people. Participants were then asked the same questions in section two but instead

corresponding to the initials provided when ranking their level of extraversion with others (for instructions see figures appendix 8-10). The sections of questions relating to weight and personality reference groups were randomised.

Figure 8 *Question eliciting rank of extroversion with others*

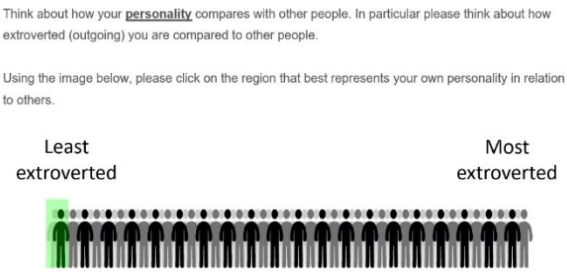


Figure 9 *Question eliciting order of sets of initials in relation to extraversion*

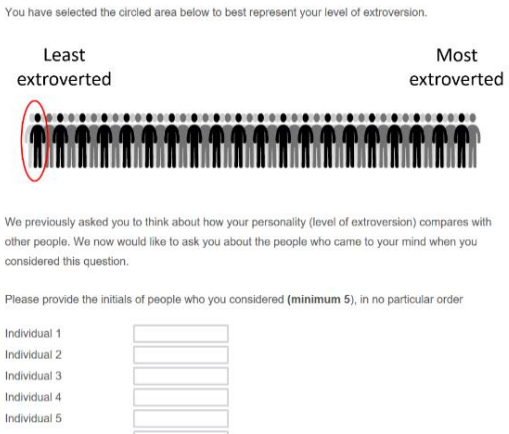
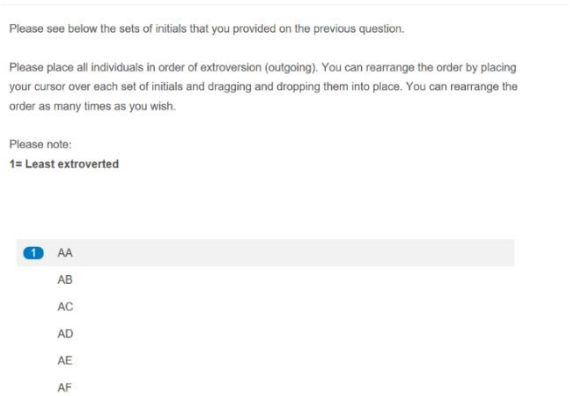


Figure 10 *Question eliciting order of sets of initials in relation to extraversion*



Next, participants completed a measure of their perceived weight status and perceived risk of diseases associated with overweight (same as study 1) and self-reported level of extraversion using the question, *"How would you describe your level of extraversion*

(outgoing)?" (Scored from 1 [not very extraverted] to 7 [very extraverted]). Measures of self-reported extraversion and weight status were randomised. Participants also completed the Ten-Item Personality Inventory (TIPI) (Gosling et al., 2003). The TIPI is a 10-item measure of the Big Five (Or Five-Factor Model) and includes two items for each of the Big-Five personality dimensions which are: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experiences. Items capture a personality dimension and are scored on a 7-point Likert scale with "1" representing "Disagree strongly" and "7" representing "Agree strongly". Each sub-scale is the sum of scores of two items, one of which is reverse-coded. In the present study, reliability (α) was high, extraversion sub-scale 0.77. The TIPI measure was chosen because it acted as an 'objective' score of personality. This was similar to the weight reference group in which participants were asked to report their own height and weight, and here BMI served as an 'objective' measure of participant's weight. BMI was used as a predictor in a multiple regression to understand whether participants use their perceived rank of weight with others to make weight related judgements e.g., weight status opposed. Participants reference group for personality acted as an opposing and control reference group to the reference group for weight. Although, learning more about the personality reference group was not the primary focus of this study, it was important that the question format was kept the same for the personality group and as a result participants answered the questions as authentically as possible. Finally, participants completed self-reported height and weight and demographics (same as study 1) (Rosa et al., 2021).

5.10. Study 2 Results

Pre-registration results

Table 6 *Means and standard deviations for weight and personality measures*

Measure	M (SD)
Perceived weight status	4.66 (1.03)
Perceived risk of diseases associated with overweight	3.19 (1.61)
Perceived extraversion	3.99 (1.59)
Extraversion (TIPI sub-scale)	3.89 (1.59)

A series of Pearson's (r) correlations were undertaken for all outcome variables (see table 7) which found rank of weight with others is highly correlated with BMI, weight status and perceived risk of disease associated with overweight. In contrast, rank of weight with others was not correlated with any of the personality related measures such as rank of personality, self-reported level of extraversion or TIPI extraversion score. However, rank of personality with others was correlated with the personality-based measures e.g., self-reported level of extraversion and TIPI extraversion score. Based on these results, measures relating to weight

and personality appear to be separate constructs and therefore one might expect there to be clear differences between the two reference groups.

Table 7 *Pearson (r) correlation matrix between weight related and personality related variables*

	Participant BMI (self-reported)	Weight status	Overweight risk	Rank (self-reported)	Actual rank	Personality rank	Extroversion self-report	Extroversion score (TIPI)
Participant BMI (self-reported)	X	.76**	.70**	.70**	.66**	.07	.05	.07
Weight status		X	.72**	.76**	.64**	-.07	-.11	-.08
Overweight risk			X	.67**	.64**	.08	-.02	.01
Rank (self-reported)				X	.61**	.07	.01	.08
Actual rank					X	.1	.03	.11
Personality rank						X	.88**	.84**
Extroversion self-report							X	.88**
Extroversion score								X

**Correlation is significant at the 0.01 level (2-tailed).

A series of linear multiple regressions were used to examine whether rank of body weight predicted perceived weight status and perceived risk of disease associated with overweight (see table 8 below). For each outcome variable, two regression models were carried out, Model A tested for participants BMI (calculated using self-reported height and weight) and Model B included rank of weight with others, both models included age and gender as covariates.

Perceived weight status. The variables entered in Model A significantly predicted perceived weight status ($p < .001$). Model B, with the inclusion of rank of weight with others revealed an increase in R^2, with rank followed by BMI explaining the most variance ($p < .001$). Table 8 shows that the results were as predicted, self-reported rank of weight among others is positively correlated with subjective weight status. The findings are consistent with study 1 and more broadly the rank hypothesis, showing that individuals are concerned about where they rank and use this to make a weight status judgement.

Perceived risk of diseases associated with overweight. BMI (with age and gender as covariates) significantly predicted participants perceived risk of disease associated with overweight ($p < .001$). However, when rank of weight was added into the model (model B), this significantly predicted risk of disease associated with overweight ($p < .001$) and revealed an increase in R^2. The results were as predicted, self-reported rank of weight among others was found to be positively correlated with the perceived risk of diseases associated with overweight. However, it should be noted that rank did not do as well as expected here with BMI explaining more variance. Nevertheless, the results support the findings from study 1 and again support that people use information about where they believe their weight ranks with others to make a weight related judgement.

Table 8 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (self-reported BMI, perceived rank of weight with others) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj.R^2	β	*p*	Adj.R^2	β	*p*
Model A		.59			.49		
	Age		.01	.90		.03	.66
	BMI (self-reported)		.73	.01		.69	.01
	Gender		.17	.01		.07	.32
Model B		.69			.55		
	Age		-.01	.91		.02	.76
	BMI (self-reported)		.43	.01		.46	.01
	Gender		.14	.01		.05	.48
	Rank (self-reported)		.44	.01		.35	.01

Note. All models control for age and gender; β = standardized regression coefficient.

Inferred Rank

The models above (table 8) suggest that people used their perceived rank of weight with others to make a body weight judgement. However, we want to clarify whether participants utilised the reference group they provided in the study when ranking their body weight. One way to do this is by calculating an inferred rank score. Participants inferred rank was calculated using their BMI score and the BMI scores of their reference group members, i.e., for each participant all BMI scores of their reference group and their own BMI were placed in ascending order. For example, if a participant had a BMI of 22, and the reference group members all have BMI scores of above 22, the participant would have an inferred rank of 1. A Pearson's (r) correlation was carried out between self-reported rank with others (taken from the question in the survey '*Think about how your body weight compares with other people'*) and inferred rank. All variables were correlated but rank with others (self-reported) and inferred rank were not as well correlated as expected (see table 9 below).

Table 9 Pearson's (r) *correlation matrix between self-reported BMI and rank scores (self-reported and inferred rank)*

	Inferred rank	Rank (self-reported)	BMI (self-reported)
Inferred rank	X	.57**	.67**
Rank (self-reported)		X	.57**
BMI (self-reported)			X

** Correlation is significant at the 0.01 level (2-tailed).

Weight Status. We ran a multiple regression to see if inferred rank predicted perceived weight status (age and gender as covariates). Here inferred rank was a significant predictor, alongside BMI (see table 10 below, model C). The same multiple regression was repeated however we added rank with others (self-reported) to understand which rank score was most important (table 10, model D). Rank with others (self-reported) explained the most variance, the inferred rank was not a significant predictor. One explanation for this result is that when participants rank their weight, they either used individuals not disclosed in the study or they have some intuition about the distribution of weights within the UK population that enters these considerations, and they base their 'rank with others' on this rather than the reference group they provided.

Perceived risk of diseases associated with overweight. We ran a multiple regression to see if inferred rank predicted perceived risk of diseases associated with overweight. Model C showed that inferred rank was a significant predictor alongside BMI. Like above, model D added rank with others (self-reported), however this time inferred rank was a significant

predictor alongside BMI, rank (self-reported) rank performs poorly (for full results see table 11).

Table 10 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (Inferred rank, perceived rank of weight with others) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj.R^2	β	*p*	Adj.R^2	β	*p*
Model C		.34			-.02		
	Inferred rank		.56	.01		.07	0.46
	Gender		-.13	.06		.07	0.44
	Age		.03	.65		.01	0.98
Model D		.66			.04		
	Inferred rank		.11	.08		.14	.18
	Age		-.12	.02		.07	.39
	Gender		.04	.44		.02	.85
	Rank (self-reported)		.44	.01		-.38	.01
	BMI (self-reported)		.35	.01		.24	.05

Note. All models control for age and gender; β = standardized regression coefficient.

Table 11 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, inferred rank, rank self-reported) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj.R^2	β	*p*	Adj.R^2	β	*p*
Model C		.57			.41		
	Age		.05	.39		.10	.18
	BMI (self-reported)		.58	.01		.40	.01
	Gender		-.14	.02		-.01	.92
	Inferred rank		.22	.01		.33	.01
Model D		.66			.41		
	Age		.04	.48		.10	.19
	BMI (self- reported)		.35	.01		.34	.01
	Gender		-.14	.01		-.01	.91
	Inferred rank		.10	.12		.30	.01
	Rank (self-reported)		.44	.01		.10	.33

Note. All models control for age and gender; β = standardized regression coefficient.

Exploratory analysis of reference groups.

Participants provided a similar number of initials for both weight and personality reference groups, average being 5.5.

BMI scores. The composition of each participants reference group was explored in relation to participants own BMI score. Figure 11 shows a plot of participants BMI scores (black dots, in ascending order) alongside the BMI scores for each member of their weight reference group (represented by green dots). Participants with a lower BMI were more likely to include people with a higher BMI than their own and less likely to think of people who weigh less than them. This finding makes sense as participants with a low BMI have a smaller pool of people to reference in the population. However, when considering participants at the upper end of the BMI distribution, there is a departure from what one might expect. Participants with high BMI scores still appear to include others with a higher BMI than themselves in their weight reference group. The composition of reference group as described above appears to be similar across genders and for personality reference group (see figure 12).

Figure 11 *Participants BMI scores (black dots) alongside the BMI scores of their weight reference group members (green dots),* left panel refers to females and right panel refers to males.

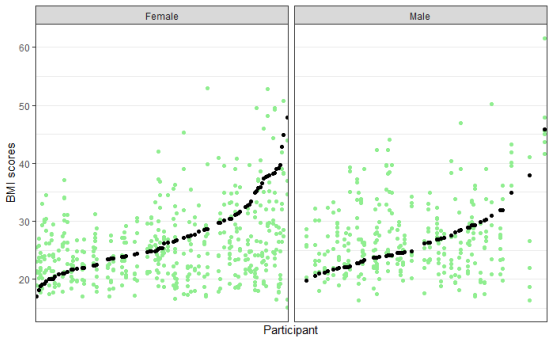
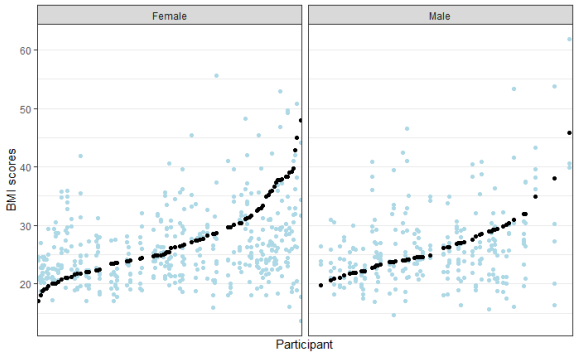


Figure 12 *Participants BMI scores alongside BMI scores of personality reference group members.*



BMI scores of participants and reference group members were classified according to NHS guidelines; underweight, healthy weight, overweight, obese, and severely obese (e.g., a BMI score of between 25 and 29.9 was categorised as healthy weight) (Health Survey for England, 2019). Regardless of participants own BMI score, participants were most likely to include a higher proportion of people with healthy weight. This was the case for all participants except for participants classed in the severely obese category who were most likely to include other people with severe obesity in their reference group. Overall, it appears participants perceived most people in their reference group to represent a healthy weight. Participants classified in the following BMI categories; overweight, obese, and severely obese, still included people with proportionally lower BMI scores alongside others with very high BMI scores than themselves. A scatterplot was created to visualise the composition of both reference groups by BMI category (see figure 13 for weight reference group and figure 14 personality reference group). The findings described above appear to apply across gender and similar results were observed for the personality reference group.

Figure 13 *Participants BMI scores alongside BMI scores of weight reference group members categorised by BMI category*

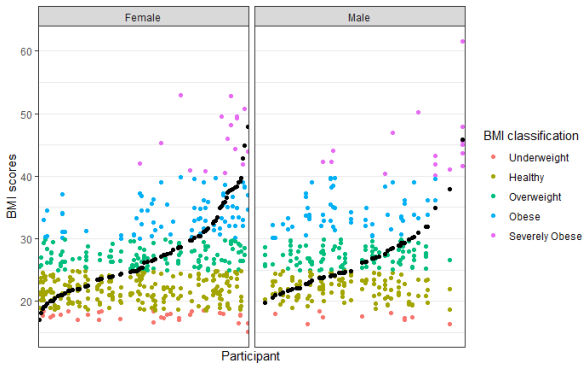
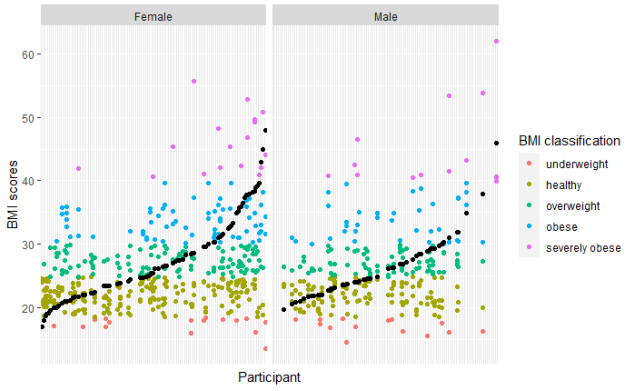


Figure 14 *Participants BMI scores alongside BMI scores of personality reference group members categorised by BMI classification*



Gender. Members of the weight reference group predominantly consisted of the same gender as the participant (see table 12).

Table 12 *Percentage of females and males included in reference groups for weight and personality by gender of the participant*

	Gender in reference group	% By gender weight reference group	% By gender personality reference group
Male participants	Male	69.2%	52.9%
	Female	30.1%	46.8%
Female participants	Male	19.4%	27.5%
	Female	79.9%	71.8%

Female participants were most likely to include other females in their weight reference group compared to any other group (females represented 79% of the weight reference group for female participants). This suggests that other females are a key source of comparison in relation to body weight. A similar pattern was observed for the personality reference group, although female participants included slightly less females here. There appears to be a difference in gender composition for male participants between weight and personality reference groups. For male participants, females represented a third of the weight reference group, however they represented nearly half of the members of the personality group. A scatterplot was created to visualise the composition of both reference groups by gender (for figure for weight reference group see figure 15 and figure 16 for personality reference group).

Figure 15 *Participants BMI scores alongside BMI scores of weight reference group members categorised by gender*

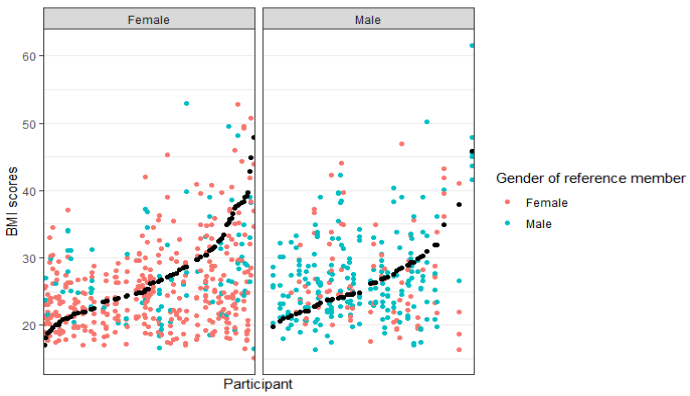
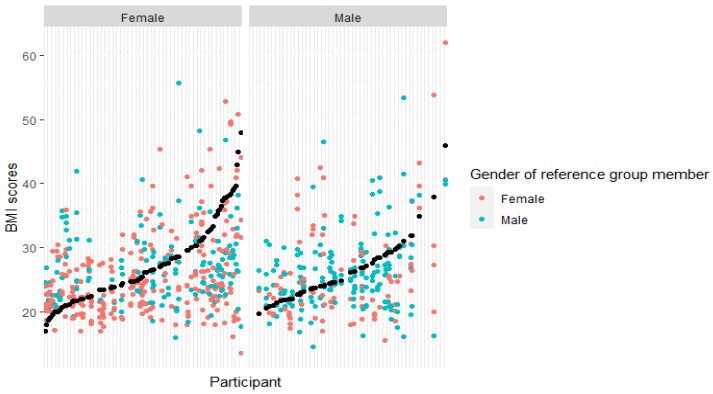


Figure 16 *Participants BMI scores alongside BMI scores of personality reference group members categorised by gender*



Category of reference group members. Participants were most likely to include friends followed by family in their weight reference group and this result was observed in females and males (see table 13 for weight reference group, table 14 for personality reference group). A similar result was observed for the personality reference group, except for a small number of 'social media influencers' (*n* = 8) selected by female participants in the weight reference group whereas no participants selected this category in the personality group. See figure 17 showing participants BMI scores alongside the BMI scores of the weight reference group members categorised by type of person in reference group and figure 18 for personality reference group.

Table 13 *Table showing total number per category of in weight reference group*

	Female	Male
Acquaintance	9(2%)	2(1%)
Celebrity	2(0%)	8(3%)
Colleague	47(10%)	58(19%)
Family	148(32%)	148(32%)
Friend	224(49%)	136(45%)
Neighbour	4(1%)	6(2%)
Other	14(3%)	2(1%)
Social Media Influencer	8(2%)	0(0%)

Table 14 *Table showing total number per category of in personality reference group*

	Female	Male
Acquaintance	12(3%)	7(3%)
Celebrity	1(0%)	6(2%)
Colleague	50(11%)	51(18%)
Family	152(34%)	89(32%)
Friend	213(48%)	121(43%)
Neighbour	3(1%)	8(3%)
Other	15(3%)	5(2%)
Social Media Influencer	0(0%)	0(0%)

Figure 17 *Participants BMI scores alongside BMI scores of weight reference group members categorised by type of person.*

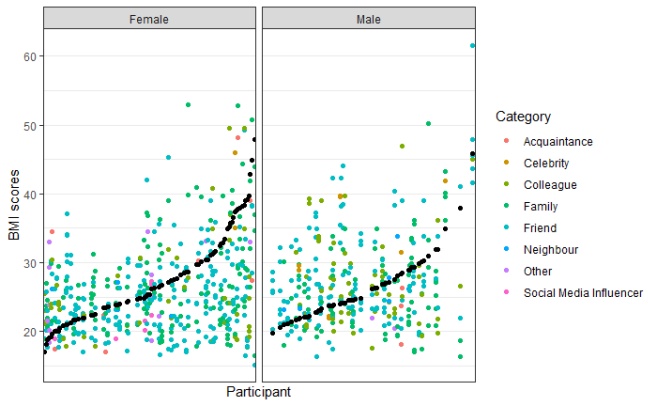
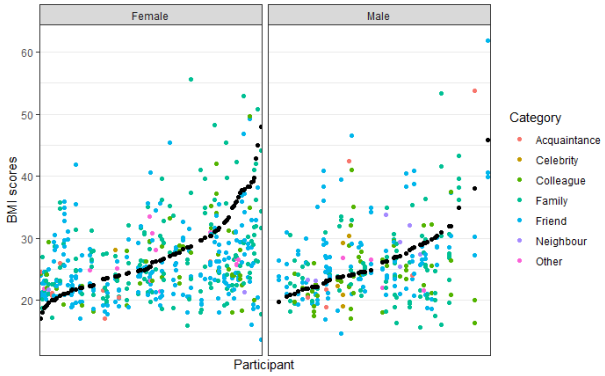


Figure 18 *Participants BMI scores alongside BMI scores of personality reference group members categorised by type of person.*



For each participant, both sets of initials (weight and personality groups) were checked for duplicates. For example, if a participant referenced the same set of initials in the weight group and the personality group this was calculated as a duplicate. Nearly a third of initials provided in the study were duplicates, suggesting that similar individuals come to mind when composing a reference group across different dimensions e.g., weight and personality (see table 15). In fact, friends represented the highest number of duplicates followed by family and colleagues (see table 16).

Table 15 *Table showing number of duplicate sets of initials across weight and personality groups.*

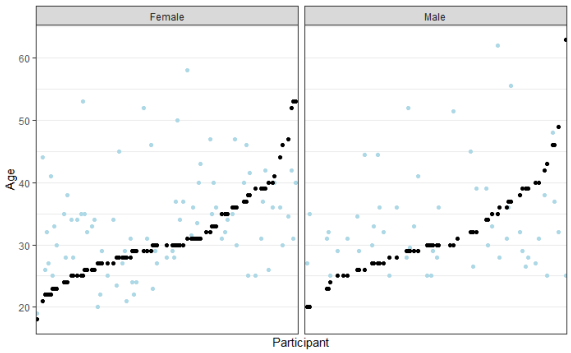
Total number of initials in both reference groups	N = 1316
Total % of duplicates across all sets of initials	N = 376 (28.5%)

Table 16 *Table showing number of duplicates by category assigned by participants*

Duplicate category	Total count	% Of total duplicates (n=376)
Friends	161	42.8
Family	132	35.1
Colleagues	39	10.4

Age. The age of participants was investigated in relation to the age of the reference group members for both weight and personality reference groups. The age of participants was plotted against the median age of members of the reference group. In the weight reference group, it appears that up until 25 years of age the median age of the reference group is above the participant's age (see figure 19) However, for participants 40 years old and above the median age is below participants. A similar pattern was observed across female and male participants and both reference groups. The results here suggest that participants didn't necessarily compare themselves to people of the same age.

Figure 19 *Age of participant alongside the median age of their weight reference group*



5.11. Study 2 Discussion

For the first part of study 2, findings were as predicted, study 2 demonstrated that rank of body weight with other people is correlated with judgements of weight status and perceived risk of overweight disease. This result is consistent with the findings of study 1 in demonstrating that people rely on rank, not just BMI, when making judgements about body weight. Study 2 results revealed insights into the composition of the reference group with whom participants ranked their weight against. Somewhat surprising is that participants with high BMI scores appear to include others with higher BMI still in their weight reference group. This might be explained by the idea that people know others with similar weights in their social network, thus making these individuals an accessible source of comparison. Research has found obesity to cluster in social networks and individuals within friendship groups have been found to gain weight over time (e.g., Christakis & Fowler, 2007; O'Malley & Christakis, 2011).

The implication of this result is that some people may base the rank of their weight on a biased sample which may have implications for weight related judgements. For example, research has found that people with overweight or obesity are more likely to underestimate their weight if their friends are overweight and/or obese (e.g., Brown et al., 2010; e.g., Maximova et al., 2008; Ramirez & Milan, 2016). Another explanation could be that people with high BMI scores do not wish to identify as overweight, obese, or severely obese and therefore recall other people with a larger BMI. Research suggests that correctly identifying with overweight or obesity can be associated with adverse psychological effects such as social stigma, poor mental health outcomes, long term weight gain and increased likelihood of disordered eating (Haynes et al., 2019). An alternative explanation to why people with high BMI scores recalled others with high BMI scores is a theory known as 'ensemble representation of groups', which proposes that recall of a set of similar objects is reduced to statistical properties of the group such as mean or range. Therefore making extreme members of a group more salient or in this instance people with very high BMI scores (Putnam-Farr & Morewedge, 2020).

It appears that participants utilised similar individuals to make judgements across different domains (weight and personality) as there was some duplication of reference group members across the two groups. This was further supported by the fact that the composition of both weight and personality reference groups did not differ greatly on domains such as the category of person referenced (e.g., friend), age, and BMI of reference group members as a product of the participants own BMI. The groups did however appear to differ on gender, female participants were much more likely to include a greater proportion of other females when constructing a reference group for weight. The percentage of females in the personality reference group decreased slightly however females still represented a large proportion of reference group members. It is possible that participants included similar others in both reference groups because they were influenced by the first reference group members they provided. However, questions relating to the weight and personality reference groups were randomised to try to minimise this effect.

Participants predominantly included friends and family in their weight reference group suggesting they are key sources of comparison for weight judgments. This finding partially supports study 1, which found that rank with friends was associated with weight status judgements. It should be noted that perceived rank of body weight with family was not tested in study 1. Based on the results of study 2, we would expect friends to be the most important reference group for weight related judgements. However, the results of study 1 and 2 are slightly at odds with one another. Study 1 primarily found that rank with the UK population (not friends) was the most important reference group for most of the outcome measures. It is

unclear whether this finding is due to a methodological problem in study 2 or whether it is revealing something else. The aim of the next study will examine rank and reference groups in a different manner.

5.12. Study 3 Introduction

From study 1 and 2, it is evident that people use relative rank to make body weight judgements. However, the results of study 1 and 2 are inconsistent with one another. Study 1 suggests that rank with UK population is important, yet study 2 suggests that participants primarily used their friends and family when ranking their weight. It is still unclear who people sample when ranking their weight, do they use people they know i.e., friends/family? or do they sample a broader distribution such as the general population? Study 3 seeks to address this by using an alternative methodology. Like study 2, participants in study 3 ranked their weight with others, completed measures of perceived weight status and perceived risk of overweight disease and provided their weight and height (to calculate BMI). To replicate the results of study 2, we ran two multiple regressions one with BMI (age and gender) and a second model added participants rank with others. Additionally, we asked participants to elicit two distributions of body weight, one distribution representing participants' beliefs about the weights of people in the UK population and a second distribution representing weights of their friends and family. Using the elicited distributions and the participants own weight, we calculated two inferred rank scores. In total there were three rank scores 1) self-reported rank (from question 'rank your weight with others') 2) rank inferred from beliefs about the UK population and 3) rank inferred from beliefs about friends and family. All three rank scores were added to multiple regressions to ascertain which is the better predictor of weight status and perceived risk of diseases associated with overweight.

5.13. Study 3 Methods

Participants

A total of 161 participants were recruited to complete an online study via the online recruitment platform Prolific. To be eligible for the study, participants needed be over 18 years old, work full time, not be a current student and live in the United Kingdom. Eligible participants accessed the questionnaire via an online survey platform Qualtrics.

161 participants (*n* = 98 females, *n* = 63 males) aged between 19 - 60 years (*M* = 34.07 years, *SD* = 9.3) were included in the data analysis. The mean body mass index (BMI) of participant's was 26.9 (*SD* = 6.9, range = 17.2-57.6). The mean BMI for female participants was 27.2 (*SD* = 7.7, range:17.2 - 57.5) and for males the mean BMI was 26.6 (*SD* = 5.2, range: 18.3 - 45.3), overall, 1.7% (*n* = 2) were underweight, 46.7% (*n* = 56) healthy weight, 25% (*n* = 30) overweight, 23.3% (*n* = 28) obese and 3.3% (*n* = 4) severely obese. The average self-reported

BMI was 27.1, this sample is comparable to national average with the average BMI in the UK 27.7 (Health Survey for England, 2019). When participants were asked to rank their weight with other people (on a scale of 1 to 20 regions on the diagram), the average score was 11.17 (SD=3.68), in general participants tended to rank themselves in the middle of their perceived distribution of weights.

Procedure

Body weight ranking. The same measure was used as Study 2 '*Think about how your body weight compares with other people. Using the image below, please click on the region that best represents your own weight in relation to others'.* Participants will select one out of a total of 20 regions, the region participants selected was represented by a green rectangle on the graphic.

Distribution elicitation. We elicited participants' beliefs about the weights of others in two different distributions 1) people in the UK population 2) friends and family. Both blocks of questions eliciting distributions (people in the UK population and friends/family) were randomised.

Participants were informed they would be asked questions about other people's weight and given a choice of metric, "*During the study we will ask you about the weights of other people. Please select your preferred metric,* ***either*** *kilograms (kg) or stone (st) and pounds (lb).* Participants were then told on the next page, "*we will ask you about the weights of* ***your friends and family.*** *Of course, you will not know the exact answers, but please give your best estimate".*

Participants were then asked to estimate the percentage of the UK population that falls within each weight range (see figure 20). Participants were presented with ten bins, one for each weight category which ranged from 6 stone to 25 stone 13 lbs or if participants opted to answer in kilograms, 38kg to 165kg (the weight categories were selected from the NHS weight chart (https://www.nhs.uk/live-well/healthy-weight/height-weight-chart/). Participants had to ensure their answers totalled 100% before moving onto the next page. Participants repeated this task for their friends and family.

Figure 20 *Question to elicit perceived distribution of weights in friends and family*

5.14. Study 3 Results

Like study 2, a series of linear multiple regressions were used to examine whether rank of body weight predicted perceived weight status and perceived risk of disease associated with overweight (see table 17 below). For each outcome variable, two regression models were carried out, Model A tested for participants BMI (calculated using participants self-reported height and weight) and Model B included rank of weight, both models included age and gender as covariates.

Perceived weight status. The variables entered in model A significantly predicted perceived weight status ($p < .01$). Model B, with the inclusion of rank of weight with others revealed an increase in R^2, with rank followed by BMI explaining the most variance ($p < .01$). Table 17 shows that self-reported rank of weight among others is positively correlated with subjective weight status. The findings are consistent with study 1 and 2, showing that individuals are concerned about where they rank and use this to make a weight status judgement.

Perceived risk of diseases associated with overweight. BMI (with age and gender as covariates) significantly predicted participants perceived risk of disease associated with overweight ($p < .01$). However, when rank of weight was added into the model (model B), this significantly predicted risk of disease associated with overweight ($p < .01$) and revealed an increase in R^2. Table 17 shows that rank of weight was found to be positively correlated with the perceived risk of diseases associated with overweight, although rank did not do as well as expected here with BMI explaining more variance. Nevertheless, the results support the

findings from study 1 and 2 and again suggest that individuals use information about where their weight ranks with others to make a weight related judgement.

Table 17 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, perceived self-reported rank of weight) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj.R^2	β	p	Adj.R^2	β	p
Model A		.64			.41		
	Age		.16	.01		.13	.05
	BMI (self-reported)		.76	.01		.62	.01
	Gender		.12	.01		.06	.31
Model B		.78			.44		
	Age		.12	.01		.11	.08
	BMI		.39	.01		.42	.01
	Gender		.12	.01		.06	.31
	Self-reported rank		.52	.01		.27	.01

Note. All models control for age and gender; β = standardized regression coefficient.

Inferred Rank. Participants inferred rank for the UK population and friends/family were calculated using their answers to the questions that elicited their perceived distribution of weights within each group. For each participant, a normal distribution was fitted, and the rank position of their own weight (kilograms) was calculated within the two distributions a) friends/family and b) UK population). One participant was removed from the data analysis because they placed all their allocated percentages into one weight bin, and therefore a distribution could not be fitted. A series of correlations were undertaken between the three rank scores (see table 18 below). Interestingly, friends/family and population inferred ranks are highly correlated.

Table 18 *Pearson (r) correlation matrix between participants self-reported- rank, friends/family inferred rank, UK population inferred rank)*

	Self-reported rank	Friends/family inferred rank	UK Population inferred rank
Self-reported rank	X	.63***	.65***
Friends/family inferred rank		X	.72***
UK Population inferred rank			X

*** Correlation is significant at the 0.001 level

Weight status and inferred rank. Friends/family inferred rank was added to model C which significantly predicted participants perceived weight status ($p < .01$) (see table 19 below). In a separate regression (model D) UK population rank significantly predicted participants perceived weight status ($p < .01$). Both inferred ranks entered separately into the regressions explain an almost identical amount of variance, making it difficult to conclude which group participants sampled over the other when ranking their weight.

Perceived overweight risk and inferred rank. Friends/family inferred rank was added to model C, variables significantly predicted perceived risk associated with overweight diseases ($p < .01$), a similar result was found when UK population was added variables into model D ($p < .01$). However, neither inferred rank scores were significant.

Table 19 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, friends/family inferred rank, UK population inferred rank) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj.R^2	β	*p*	Adj.R^2	β	*p*
Model C		.66			.38		
	Age		.13	.01		.12	.07
	BMI (self-reported)		.63	.01		.56	.01
	Gender		.15	.01		.07	.28
	Friend/family rank		.20	.01		.05	.57
Model D		.66			.38		
	Age		.15	.01		.12	.06
	BMI (self-reported)		.62	.01		.52	.01
	Gender		.15	.01		.08	.24
	UK Population rank		.18	.01		.10	.32

Note. All models control for age and gender; β = standardized regression coefficient.

It appears that the earlier multiple regression models which included 'rank with others' (self-reported rank) (model A and B) resulted in a higher R^2 than models C and D. Both inferred ranks were inserted into the model below (model E, table 20 below) to determine if a) one is a better predictor over the other b) if the overall strength of the model increases.

Table 20 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, friends/family rank, UK population rank) towards outcome variables (weight status, overweight risk)*

		Weight status			Overweight risk		
		Adj. R^2	β	*p*	Adj. R^2	β	*p*
Model E		.66			.38		
	Age		.13	.01		.12	.07
	BMI (self-reported)		.58	.01		.51	.01
	Gender		.16	.01		.08	.23
	Friend/family rank		.16	.02		.02	.86
	UK Population rank		.11	.19		.09	.41

Note. All models control for age and gender; β = standardized regression coefficient.

Weight status and inferred ranks. The variables entered in the regression predicted weight status ($p < .01$), only inferred friends/family rank was a significant predictor for weight status, inferred rank with the UK population was not significant.

Perceived risk of diseases associated with overweight and inferred ranks. The variables entered in the regression predicted perceived risk of diseases ($p < .01$), however neither inferred rank scores were significant predictors. Seeing as the adjusted R^2 is largest for the original rank regression (model B, see table 17), it is possible that people sample a mixture of both friends/family and UK population when ranking their weight with others, which they utilised to inform their subjective body weight judgements.

A final regression (model F, see table 21 below) included both inferred ranks to predict self-reported rank score ('rank with others'). Variables entered into the regression significantly predicted participants self-reported rank score ($p < .01$). Notably, friend/family rank was a significant predictor for rank. Taken here, model E supports the results of model F, that participants sampled a distribution of their friends/family when ranking their weight with 'others'.

Table 21 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, friends/family inferred rank, UK population inferred rank) towards self-reported rank with others.*

		Adj.R^2	β	*p*
Model F		.57		
	Age		.03	.57
	BMI (self-reported)		.46	.01
	Gender		.07	.21
	UK population rank		.13	.17
	Friends/family rank		.25	.01

Note. All models control for age and gender; β = standardized regression coefficient.

5.15. Study 3 Discussion

Like study 1 and 2, the results of the study 3 support that people use rank to make subjective judgements. The aim of study 3 was to try to understand whether participants use their underlying beliefs about the distribution of weights in the UK population or their friends/family to rank their weight and subsequently inform subjective weight judgements. Based on the results of study 3, it is still unclear which distribution people used over another when ranking their weight. Although, the results suggest that participants may have sampled the weights of friends and family slightly more.

In terms of weight status judgements, both inferred ranks explained a similar amount of variance. One explanation for this finding could be that both distributions of weights in friends/family and distribution of weights in the UK population come to mind when participants ranked their weight with others. Another possible reason for the results could be a limitation of the format of the questions used to elicit the distribution of friends/family and the UK population i.e., slider question type. This method did not necessarily obtain an

estimated weight for each percentile for every participant (e.g., some participants may have only allocated percentages to two to three weight bins). An alternative method could be used to elicit beliefs about the social distribution, participants estimate different percentile points of the distribution, ensuring that a full distribution is obtained, for example "The highest consuming X% of students eat more than _bars of chocolate per week" where X had values of [10,20,30,40,50,60,70,80 and 90] (e.g., Achtypi et al., 2021; Aldrovandi et al., 2015a).

5.16. General Discussion

In the present paper, three studies explored who people rank their weight with when making body weight judgements. Study 1 examined whether people indeed use rank to make judgements and tested this against different populations. It appeared that participants sampled friends when ranking their weight with others and used this to make a judgement about perceived weight status. Whereas for the remaining outcome variables, rank among the UK population appeared to be an important reference group. Study 2 explored reference groups using an alternative methodology, participants ranked their weight with 'others' and provided further information about the individuals sampled. Study 2 revealed that friends and family and people of the same gender as the participant appeared important for body weight judgements. Study 3 suggests that people sample both their friends/family and the UK population but may rely more on their friends and family when ranking their weight with others and they use this information to make subjective judgements about body weight.

Taken together, results from these studies have important theoretical and applied implications. Firstly, the findings offer insights into explaining the cognitive mechanisms behind *how* people make body weight judgments. The findings extend knowledge around body weight judgements as well as relative rank by applying it to a new domain. Secondly, the findings address limitations of previous social judgment studies by directly examining reference group composition (e.g., Galesic et al., 2018a; Putnam-Farr & Morewedge, 2019).. The findings have broader implications, similar methods should be used by researchers to explore reference group composition in other domains.

The results described here have important implications for weight. Sensitivity to rank position amongst others may maladaptively lead some people to assume that they weigh less and are less at risk of diseases associated with overweight than they objectively are. Given this, the results may inform future social norms interventions. Typically social norms for interventions offer information on how ones undesirable behaviour compares to others, however the effectiveness of such interventions are limited (Aldrovandi et al., 2015a). By demonstrating the importance of rank in body weight judgements, it may prove beneficial to provide individuals with information about where they rank opposed to how they compare

with the 'average' person. This approach is believed to be more effective than a typical social norms interventions, rank based interventions could inform people where they rank amongst a broader reference group (e.g., 'you're in the top 70% of the UK population at risk of diseases associated with overweight') (e.g., Aldrovandi et al., 2015a; Moore et al., 2016). This is also important in the context of social media. A recent systematic review suggests it is common for users to make appearance based upward comparisons when spending time on social media. This can have negative consequences for body dissatisfaction and weight control behaviours (Rounsefell et al., 2020). Interestingly peers have been identified as the most relevant reference group for these comparison on body weight, opposed to celebrities or images within magazines (Fardouly et al., 2017). Given that friends appear to be an important reference group when judging weight status, future research could examine whether social media users rank themselves with others on 1 such as Instagram and whether this influences subjective judgements towards eating behaviours.

A possible limitation of the present study is that BMI (calculated using participants self-reported height and weight) was used as an objective measure of body weight. A limitation of BMI is that it doesn't consider body fat distribution or body size, despite this, BMI is a widely used measure by researchers (Nuttall, 2015). The figures used in the ranking scenarios were all visually the same size and height and consequently appear to be the same weight. This is important as evaluating the perceived weight of oneself and other people may be partially determined by body fat distribution (Lewis et al., 2015). Future studies could consider utilising different images to represent different body sizes and shapes such as 3D images, as used in studies by Harris et al. (2008) and Oldham and Robinson (2017). Using 3D models in an experimental design would allow us to directly test sensitivity to rank in different social contexts and examine whether people rely on the mean or rank to make a weight judgement (see Aldrovandi et al., 2015b; Maltby et al., 2016). It may also be interesting to explore rank effects to a related area to body weight such as disordered eating behaviours (e.g., restrained eating). It is currently unclear how people perceive the distribution of eating behaviours (e.g., restrained eating) within reference groups and whether where they rank their own behaviour with others informs subjective judgements relating to eating.

5.17. Conclusion

In summary, the findings demonstrate that by showing that rank of weight with others is important for body weight related judgements. The findings help to understand the cognitive mechanisms behind *how* individuals make judgements about their body weight. This study has also made a key advance for social judgement studies by exploring exactly who people sample in their reference group, and our methodology can be applied to other domains. Future

research should investigate the composition of reference groups within different domains and alternative methodologies.

5.18. Chapter 5 Summary

This chapter reported on the findings of studies 1, 2 and 3, which began with aims and objectives for chapter five. Then, the context of the three studies were discussed in relation to the findings of the systematic review (chapter two). Next, the abstract and an introduction for studies 1, 2 and 3 was provided. Following this, the findings of studies 1, 2 and 3 were presented. Then, a general discussion of all three studies which compares the findings to existing literature, the implications of the findings and limitations of the studies. Findings from chapter five (studies 1, 2 and 3) suggest that people use rank with other people to make a body weight judgement. These studies explain the cognitive mechanisms behind *how* people make body weight judgements and provide further information about who they sampled in their distribution when ranking their weight with other people. Studies presented in the next chapter will build upon these findings and test for rank sensitivity using experimental methods.

Chapter 6: Rank based sensitivity in subjective perception of weight

6.1. Chapter 6 Overview

This chapter reports on the findings of studies 4 and 5 which begins with aims and objectives. Then, the context of the two studies will be discussed in relation to the findings of chapter five (studies 1, 2 and 3). The abstract and an introduction for studies 4 and 5 is then provided, followed by the findings. Next, a general discussion of both studies which compares the findings to existing literature, considers the implications of the findings and limitations of the studies, followed by a chapter summary.

6.2. Aims

- To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight* (scale 1 'very underweight' to 5 'very overweight') of male 3D figures **(study 4)**
- To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight status* (e.g., overweight) of male 3D figures **(study 5)**

The following chapter has been prepared for publication as Clohessy, S., Meyer, C., & Walasek, L. (in preparation) (2022) Rank based sensitivity in subjective perception of weight.

6.3. Abstract (Studies 4 and 5)

Aim: In two studies, two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight were tested. The first account posits that people's judgments reflect sensitivity to the mean of a comparison context; the second is that people are sensitive to the rank position of a judged stimuli among other stimuli in a comparison context.

Method: In study 4, participants were asked to judge the weight of male 3D figures (on a 1 'very underweight' to 5 'very overweight' scale) which varied in waist size. Participants were randomly allocated to one of four distributions of the 3D figures that differed in shape (unimodal, bimodal, positively, or negatively skewed). Study 5 used the same manipulation as study 4, but participants were asked to judge the weight status of each figure using descriptive categories (i.e., underweight, healthy weight, overweight, obese, severely obese).

Results: The judged weight of 3D figures with common objective waist sizes (same in all distributions) were judged differently depending on where they ranked in a comparison context. Differences in judgments observed between bimodal and unimodal distributions

cannot be explained by a model in which people are sensitive to the mean of the comparison sample but can be accounted for by a rank-based model of judgment.

Conclusions: Judgment of weight in context appear to be sensitive to the rank position of one's weight relative to the weights of others. These results lend further support to rank-based models of human judgment and offer insight into the exact mechanisms by which people judge weight of themselves and others (e.g., overweight and obesity). Future interventions should be informed by the exact cognitive mechanisms that can explain pervasive context sensitivity in human judgment.

6.4. Introduction

People have studied judgements of weight in health psychology and in fact many studies on weight judgements have shown bias (both for overestimation and underestimation of objective weight) (e.g., Elia et al., 2020; Jackson et al., 2015; Perkins et al., 2010; Robinson & Oldham, 2016). For example, research has found that people with overweight and obesity are more likely to underestimate their objective weight status (e.g., Johnson et al., 2014a; Muttarak, 2018; Oldham & Robinson, 2015; Oldham & Robinson, 2017; Yaemsiri et al., 2011). However, what is the mechanism behind these incorrect judgements of weight? In explaining this result, researchers have attributed this source of bias to social comparison with a reference group. Specially, researchers have proposed the visual normalisation theory (e.g., Robinson, 2017; Robinson & Kersbergen, 2017). This theory suggests that people compare their weight to others in a reference group to make a weight judgement. In fact, it suggests that the comparison context often consists of people with overweight and obesity due to the high rates of overweight and obesity in society (Robinson, 2017). What do they do with the sample? Researchers propose that people use a mean of the combined weights within a comparison sample to inform a weight judgement (Robinson, 2017). However, this paper challenges this theory, by suggesting that people rely on *rank* to make a judgment. Extensive research studies suggest that people use rank, it forms part of theories and models of social judgements such as *Decision by Sampling theory* (Parducci, 1965; Stewart et al., 2006). Indeed, studies 1-3 (chapter 5) provided evidence for a rank-based theory when making weight judgements. In the present paper, we are not exploring how people underestimate their weight (if overweight or obese). This paper is in fact an investigation into the type of statistics people use when making a judgement (e.g., rank vs mean), we are interested in what informed their judgement. The results of these studies have wider implications for how people make judgements than previous studies investigating weight judgements. This is because we are not making a position for underestimation or overestimation of weight as either could happen

when judging weight, but we are exploring what informs these types of judgements more generally.

The rank principle can be used to explain how people make body weight judgements, embodied in rank models, including *Range Frequency Theory* (RFT) and *Decision by Sampling* (DbS) (Parducci, 1965; Stewart et al., 2006). Unlike the reference levels theories (which propose that people rely on mean of a sample to make a judgment), rank models propose that people's subjective judgments of a given quantity reflect its rank within a given context of comparable stimuli (e.g., Aldrovandi et al., 2015b). Relative rank is a key component of the *Decision by Sampling theory* which suggests that a subjective value of a stimulus is based on a series of ordinal, binary comparisons in a sample (e.g., a target item is compared to every other item in a sample (binary) and then judged to be either smaller or larger than that comparator (ordinal). Depending on the distributional properties of the context, the same stimuli may be judged differently depending on its rank position i.e., the same body size may seem smaller or larger if the comparison context changes. Over the years, rank-based explanations of judgments have been compared with the predictions of mean-based models of judgment. A rank-based explanation has been shown to better account for how context influences people's judgments across numerous domains including; depression and anxiety symptoms, alcohol consumption, personality, health benefits of exercise and food healthiness (e.g., Aldrovandi et al., 2015a; Maltby et al., 2012; Melrose et al., 2013; Wood et al., 2011; Wood et al., 2012). For example, Aldrovandi et al. (2015a) found that concern about unhealthy food intake (e.g., chocolate bars) was driven by individuals' beliefs about where their own consumption ranks among others, not by the mean consumption of chocolate bars. Rank of income, not actual objective income, has been found to influence subjective wage satisfaction and life satisfaction more generally (e.g., Clark & Oswald, 1996; Macchia et al., 2020). One way to tease apart predictions of the mean-based and rank-based account is to compare judgments of the same quantity across comparison contexts that are unimodal and bimodal in shape (e.g., Aldrovandi et al., 2015b; Wood et al., 2011). For example, in the study by Aldrovandi et al. (2015b) participants were shown 11 quantities of student debt and were asked to rate their level of concern with each debt amount (assuming it was theirs). Participants were allocated to different distributions of debt amounts (unimodal or bimodal). Both distributions shared the same mean, but target debts differed in how they ranked among other debts in the comparison sample. The mean ratings of concern were compared across common debt amounts in each distribution. If participants utilised the mean, all the common debt amounts should be rated the same regardless of the distribution. However, participants held differing

levels of concerns for the common debt amounts, demonstrating that they relied on rank for their judgments rather than the distance from the mean.

Recently, a series of studies demonstrated that people rely on rank to make body weight judgement (e.g., weight status) (Clohessy et al., 2021a, 2021b). However, research has not experimentally investigated how a mean-based model compares with a rank-based model in relation to weight judgements. Testing the two models will help to understand the cognitive mechanisms behind how people form subjective weight judgements. To demonstrate that people's judgments are sensitive to rank, it is necessary to experimentally manipulate the rank position of a stimuli within its comparison context.

In summary, current research in weight perception literature suggests that when people judge body weight they utilise an 'internal average' of what they believe constitutes a 'normal weight' (Robinson & Kersbergen, 2017). However, research across different domains suggest that people rely on rank when making judgments (e.g., Aldrovandi et al., 2015b; Boyce et al., 2010). Despite this, there is a lack of experimental research that would directly compare the two accounts in the context of weight judgments. The aim of the present studies is to compare a) rank with b) a mean-based model. The two studies presented in this paper will use an experimental design to directly manipulate rank and test whether the rank position of figures with the same waist size in four different distributions affects judgements of weight (study 4) and perceived weight status (study 5).

6.5. Study 4 Methods

Participants

A total of 212 participants were recruited via the online recruitment platform Prolific (https://www.prolific.co/). To be eligible for the study, participants needed to be over 18 years old and live in the United Kingdom. Eligible participants accessed the questionnaire via an online survey platform Qualtrics (https://www.qualtrics.com/uk/).

72.6% (*n* = 154) of participants were females, 25.9% (*n* = 55 males), 0.5% (*n* = 1) nonbinary and 0.9% (*n* = 2) did not disclose their gender. Participants' ages ranged between 18 and 73 (*M* = 33.5, *SD* = 12.1) and 74.5% (*n* = 158) classified themselves as White-English/Welsh/Scottish/Northern Irish/British.

The mean BMI score was 27 (*SD* = 7.1), and participants' BMI scores were classified within the following categories of weight: 4.7% (*n* = 10) were underweight, 40.6% (*n* = 86) were healthy weight, 26.9% (*n* = 57) were overweight, 23.6% (*n* = 50) were obese and 4.2% (*n* = 9) severely obese (Health Survey for England, 2019). BMI scores within this sample were typically lower than the general population, given that two thirds of the UK population is classified as overweight or obese (Health Survey for England, 2019).

This research was approved by the University of Warwick's Biomedical and Scientific Research Ethics Sub-Committee (approval BSREC REGO2019-2326).

Procedure

The study was advertised as being about how people make judgements about the weight of other people. Using a between subject's design, participants were randomly assigned to one of four conditions that differed in the distribution of contextual stimuli: unimodal (24%, *n* = 51), bimodal (23%, *n* = 49), negatively skewed (27%, *n* = 57), positively skewed (26%, *n* = 55),

In each condition, participants were shown 11 male 3D figures simultaneously (figure 8) and asked to judge the weight of each circled figure (Scored from 1 'Very Underweight' to 5 'Very Overweight'). This was repeated for each of the 11 figures (shown to participants on a separate page each time). Question about figures appeared in a random order for each participant.

Following the perceived body weight task, participants completed the following measures:

Weight status. To measure participants perceived weight status, participants were asked, *'How would you describe your weight as?'* (Scored from 1 'very underweight' to 5 'very overweight').

Objective weight measurement. To calculate BMI, participants provided self-reported weight (either using kilograms or stone and pounds) and height (either using cm or feet and inches).

Demographic information. Participants answered a series of demographic questions (gender, age, ethnicity).

Stimuli creation

The 3D stimuli were created using a 3D modelling software package, 'Body Visualiser' developed by the Max Planck Intelligence Institute 'Perceiving Systems' research group. The 3D images representing different weights were created using a statistical model of human body shape created from thousands of detailed laser range scans of human bodies, similar methods to those employed in experimental studies by Pujades et al. (2019).

In total, 17 3D male models of increasing waist size were created (see appendix 4 for full distribution of figures). The male figures were selected in front pose and kept in the default colour (light blue). The figures were based on the average height of a male in the UK (175cm), the height was locked to ensure it remained the same for each figure (see figure 21 below). Using information about real life waist sizes, we manipulated the waist of the male figures to range from 64cm to 128cm (males are considered at risk for diseases associated with

overweight if their waist size is between 94cm-102cm and very high if over 102cm, 59% of males in England have a waist size of 94cm and above) (Health Survey for England, 2019). The waist sizes of the figures were increased using a slider for waist size, which automatically adjusted the figures measurements on other domains such as weight in kilograms. We calculated the range of the waist sizes (64cm - 128cm) and divided those into 17 equal distances, with a difference of 4cm (waist size) between each stimulus (see table in appendix 5 for exact dimensions of each figure). The images within each distribution were 'grouped together' and saved as a picture (12cm high by 87cm wide) (see figure 22 below and table 22 for exact waist sizes included in each distribution). Using waist and height measurements, we were also able to calculate a BMI score and so calculate the weight status of each 3D figure e.g., obese. Only male stimuli were used in the two studies. The reasoning behind this is that previous research has found that other people commonly tend to underestimate the weight of males with overweight and obesity (Oldham & Robinson, 2017; Robinson & Oldham, 2016). Therefore, testing whether people are sensitive to where a stimuli ranks in different contexts will provide an explanation of the cognitive mechanisms behind why people underestimate the weight of males with overweight and obesity. Future research may replicate the two studies with females at a later stage.

Figure 21 *Screenshot depicting creation of 3D figure by adjusting height and waist sliders*

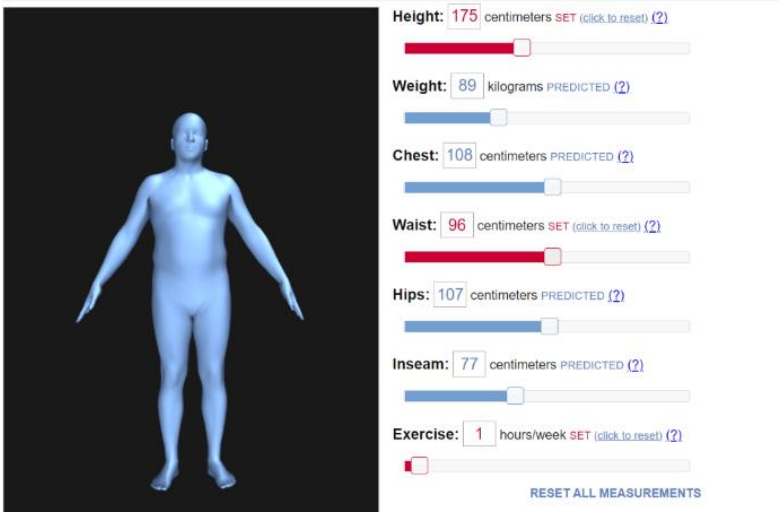
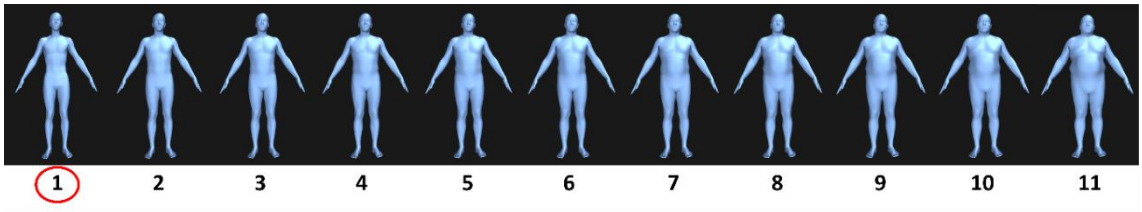


Figure 22 *Unimodal male distribution*



Distributions

Participants were allocated to one of four distributions; unimodal (most waist sizes are near the middle of the distribution), bimodal (most waist sizes are in the smallest or largest third), positively skewed distribution (most waist sizes are in the smallest part of the distribution) and negatively skewed (most waist sizes are in the largest part of the distribution) (see figures in appendix 6-8). We tested for context effects in all conditions by manipulating the rank position of common waist sizes. However, only the bimodal versus unimodal distributions have the same mean, which allowed us to test a rank- based model against the mean-based model.

Unimodal and bimodal distributions: There were five common waist sizes across the unimodal and bimodal distributions. Waist sizes 64cm (rank 1st), 96cm (rank 6th) and 128cm (rank 11th) all had the same rank in both unimodal and bimodal distributions. Waist size 80cm ranked 2nd in the unimodal distribution and rank 5th in the bimodal distribution. Likewise, we expected waist size 112cm ranked 10th in the unimodal distribution and ranked 7th in the bimodal distribution.

If participants simply judged the weight of the common waist sizes in isolation then each figure should have received a similar weight judgement across the experimental groups. However, if judgements are based on rank, we expected waist size 80cm to be perceived as a lower weight in the unimodal distribution compared to bimodal distribution and waist size 112cm to be perceived as a higher weight in the unimodal distribution compared to the bimodal distribution. If judgements are based on rank, we expected common waist sizes across both distributions to elicit similar weight judgements (waist sizes 64cm, 96cm, 112cm).

Positively and negatively skewed distributions: There were three common waist sizes across the positively and negatively skewed distributions; waist sizes 64cm (rank 1st) and 128cm (rank 11th) both ranked the same across distributions. Waist size 96cm ranked higher in the positively skewed distribution (rank 8th) and lower in the negatively skewed distribution (rank 4th).

If judgements are based on rank we expect the waist sizes ranked in the same position across both distributions to be rated similarly (64cm and 128cm) and waist size 96cm to be

rated higher in the positively skewed distribution (rank 8th) compared to the negatively skewed distribution (rank 4th).

Table 22 *Four distributions and waist sizes. Crosses indicate which 3D figures made up a comparison context in each condition.*

Common point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Unimodal	X				X	X	X	X	X	X	X	X	X				X
Bimodal	X	X	X	X	X				X				X	X	X	X	X
Positive	X	X	X	X	X	X	X		X	X			X				X
Negative	X				X			X	X		X	X	X	X	X	X	X
Waist size (cm)	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128

6.6. Study 4 Results

Unimodal and bimodal distributions

First, we compared participants responses for questions in the unimodal and bimodal distributions. Figure 23 (panel on the left) shows participants responses for the five common waist sizes. Table 23 (below) shows comparisons of the mean weight judgement for the unimodal and bimodal groups across each common point, reporting independent samples *t*-test and *p*-value.

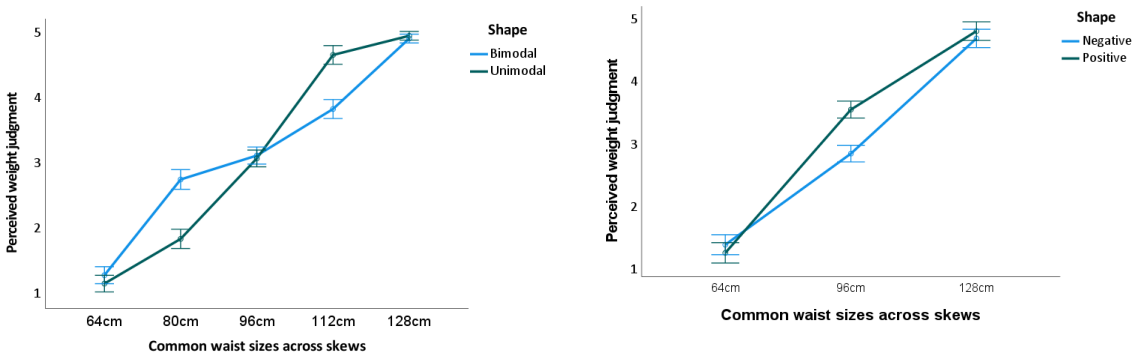
Waist size 64cm (rank 1st) was ranked in the same position across distributions, responses were very similar across the two conditions (Unimodal: *M* = 1.16, *SD* = 0.42; Bimodal: *M* = 1.29, *SD* = 0.50). Likewise, responses were similar for waist size 96cm (rank 6th) across the two distributions, (Unimodal: *M* = 3.08, *SD* = 0.48); Bimodal: *M* = 3.12, *SD* = 0.44), similar results were found for waist size 128cm (rank 11th) (Unimodal: *M* = 4.96, *SD* = 0.20); Bimodal: *M* = 4.92, *SD* = 0.28). However, and in line with the rank-based explanation, participants perceived waist size of 80cm to be more overweight in the bimodal distribution (*M* = 2.76, *SD* = 0.43) where it ranked higher (rank 5th) than in the unimodal distribution (*M* = 1.84, *SD* = 0.61) where it ranked lower (rank 2nd). On the other hand, participants perceived waist size of 112cm to be more overweight in the unimodal distribution (*M* = 4.67, *SD* = 0.59) where it ranked higher (rank 10th) compared with the bimodal distribution (*M* = 3.84, *SD* = 0.43) where it ranked lower (rank 7th).

The differences in judgments were statistically significant. In a 5 (within: common waist size) x 2 (between: distribution) mixed ANOVA there was a significant main effect of common waist size $F(4, 95) = 1290.76$, $p < .001$, partial eta squared = 0.98. There was no significant main effect of distribution on weight judgements, $F(1,98) = .63$, $p < .43$, partial eta squared = 0.627 but there was a significant common waist size by distribution interaction, $F(4, 95) = 41.162$, $p < .001$, partial eta squared= .63, suggesting that the weight judgment of figures varied as a function of rank of that figure within each condition.

Table 23 *Means and standard deviations for perceived weight relating to five different figures, by unimodal and bimodal group*

Common point	Waist size	Unimodal rank	Bimodal rank	Unimodal	Bimodal	*t*	*p*
1	64	1st	1st	1.16(sd=0.42)	1.29(sd=0.5)	1.40	0.17
2	80	2nd	5th	1.84(sd=0.61)	2.76(sd=0.43)	8.56	0.01
3	96	6th	6th	3.08(sd=0.48)	3.12(sd=0.44)	0.48	0.64
4	112	10th	7th	4.67(sd=0.59)	3.84(sd=0.43)	-8.10	0.01
5	128	11th	11th	4.96(sd=0.20)	4.92(sd=0.28)	-0.89	0.34

Figure 23 *Perceived weight judgements of figures with common waist sizes by distribution type (Bimodal vs Unimodal on left and Negative vs Positive on right). Error bars represent 95% confidence intervals*



The figures above show the common waist sizes across the distribution of figures (Bimodal/Unimodal and Negative/Positive) and perceived weight judgement of figures. An example, graph on the right shows that when figures with the same waist size (96cm) were ranked differently in different distribution, the weight of the same figure (96cm) was judged as a smaller weight in the negative distribution compared to the positive distribution. Graph on the left shows when common waist size (96cm) ranked in same position across distributions, participants judged the figures weight similarly.

Positively and negatively skewed distributions

Next, we compared participants responses for questions in the positively and negatively skewed distributions. Figure 23 (panel on the right) shows participants responses for the three common waist sizes across the positively and negatively skewed distributions. Table 24 (below) shows comparisons of the mean weight judgement for the positively and negatively skewed groups across each common point, reporting independent samples *t*-test and p-value

As expected, weight judgements for waist sizes with the same rank in the two distributions were rated very similarly, waist size 64cm (rank 1st) (Positively skewed distribution: *M* = 1.27, *SD* = 0.53; Negatively skewed distribution: *M* = 1.40, *SD* = 0.68) and waist size 128cm (rank 11th) (Positively skewed distribution: *M* = 4.82, *SD* = 0.43; Negatively skewed distribution: *M* = 4.70, *SD* = 0.66).

Next, we compared the mean rating for waist size 96cm (rank 4th in the negatively skewed distribution vs rank 8th in the positively skewed distribution). In line with the rank principle, participants perceived waist size 96cm to be more overweight in the positively skewed distribution (*M* = 3.56, *SD* = 0.54) where it ranked higher (rank 8th) than in the negatively skewed distribution (*M* = 2.86, *SD* = 0.48) where it ranked lower (rank 4th).

A 3 (within: common waist size) x 2 (between: distribution) mixed ANOVA showed a significant main effect of common waist size on weight judgements, $F(2, 109) = 692.907$, $p < .001$, partial eta squared= .93, and a significant main effect of distribution on weight judgements, $F(1, 110) = 16.572$, $p < .001$, partial eta squared= .131. There was a significant common waist size by distribution interaction, $F(2, 109) = 23.53$, $p < .001$, partial eta squared=.302, again suggesting that the weight judgment of figures were dependant on the rank position of that figure within each distribution.

Table 24 *Means and standard deviations for perceived weight relating to five different figures, by positive and negative group*

Common point	Waist	Positive rank	Negative rank	Positive	Negative	*t*	*p*
1	64	1st	1st	1.27(sd=.53)	1.40(sd=.68)	1.14	.26
2	96	8th	4th	3.56(sd=.54)	2.86(sd=.48)	-7.32	.01
3	128	11th	11th	4.82(sd=.43)	4.70(sd=.66)	-1.11	.27

6.7. Study 4 Discussion

The results support the hypothesis that people's perceptions of weight of others are influenced by the relative rank position of a given weight among others. The critical test of this proposition is that figures with the same waist sizes were judged significantly differently depending on where they ranked within a distribution. These effects were non-trivial in magnitude. The figure with the waist size of 96cm was judged on average as 3.56/5 (Scored from 1 'Very Underweight' to 5 'Very Overweight') in the positively skewed distribution compared to 2.86/5 in the negatively skewed distribution. In study 4, participants were asked to rank the figures on a 1-5 scale anchored with 'very underweight' and 'very overweight'. One possible explanation for the findings of study 4 is that participants allocated to different conditions may have differed in their interpretation of each scale item. To show that the context influences people's judgments concerning other people's weight, in study 5 we used descriptive labels corresponding to NHS weight categories based on BMI scores (underweight, healthy weight, overweight, obese, and severely obese) (Health Survey for England, 2019). If the results of study 4 are replicated, this will lend further support for the proposition that context influences people's subjective judgment of weight.

6.8. Study 5

Participants

A total of 202 participants were recruited via the online recruitment platform prolific (https://www.prolific.co/). The same inclusion criteria from study 4 applied.

202 participants data were included in the data analysis; 62.4% (*n* = 126) females and 36% (*n* = 72), 0.01% (*n* = 2) identified as other and 0.01% (*n* = 2) did not disclose their gender, one participant was excluded as data was missing from their questionnaire.

Participants were aged between 18 and 72 (*M* = 30, *SD* = 9.8) and 68.3% (*n* = 138) classified themselves as White-English/Welsh/Scottish/Northern Irish/British. The mean BMI score was 25.7 (*SD* = 6) and ranged between 13.9 - 66.1, of which 5.9% (*n* = 12) were underweight, 45.5% (*n* = 92) were healthy weight, 31.7% (*n* = 64) were overweight, 14.4% (*n* = 29) were obese and 2.5% (*n* = 5) severely obese, like study 1 the weight of participants was lower than in the UK general population.

5.4% (*n* = 11) identified as underweight, 45% (*n* = 91) identified as healthy weight, 36.1% (*n* = 73) identified as overweight, 9.4% (*n* = 19) identified as obese and 4% (*n* = 8) identified as severely obese.

Participants were randomly allocated to one of four distributions: unimodal (24%, *n* = 49), bimodal (24%, *n* = 48), positively skewed (25%, *n* = 51), and negatively skewed (27%, *n* = 54). The distributions were the same as study 4.

Procedure

The procedure remained the same for study 5, however participants made a judgement about the weight of each figure using the following weight categories; underweight (below 18.5), healthy weight (18.5 - 24.9), overweight (25 - 29.9) obese (30 - 39.9), severely obese (above 40). Participants were shown the NHS BMI guidelines for each category before commencing the study (Health Survey for England, 2019). When participants were asked about their perceived weight status, participants selected a response from the above weight categories instead of a 1-5 scale from study 4.

6.9. Study 5 Results

Unimodal and bimodal distributions

We compared participants responses for questions in the unimodal and bimodal distributions. Figure 24 (panel on the left) shows participants responses for the five common waist sizes across unimodal and bimodal distributions. Table 25 (below) shows comparisons of the mean weight judgement for the unimodal and bimodal groups across each common point, reporting independent samples *t*-test and *p*-value.

First, we compared the mean ratings for the waist sizes that were ranked in the same position in both unimodal and bimodal skewed distributions. As expected, for the waist sizes, 64cm (rank 1st), 96cm (rank 6th), 128cm (rank 11th) responses were very similar across the two distributions (like study 1). For example, waist size 64cm (Unimodal: *M* = 1.08, *SD* = 0.28; Bimodal: *M* = 1.10, *SD* = 0.31). Waist size 96cm (Unimodal: *M* = 2.57, *SD* = 0.50; Bimodal: *M* =

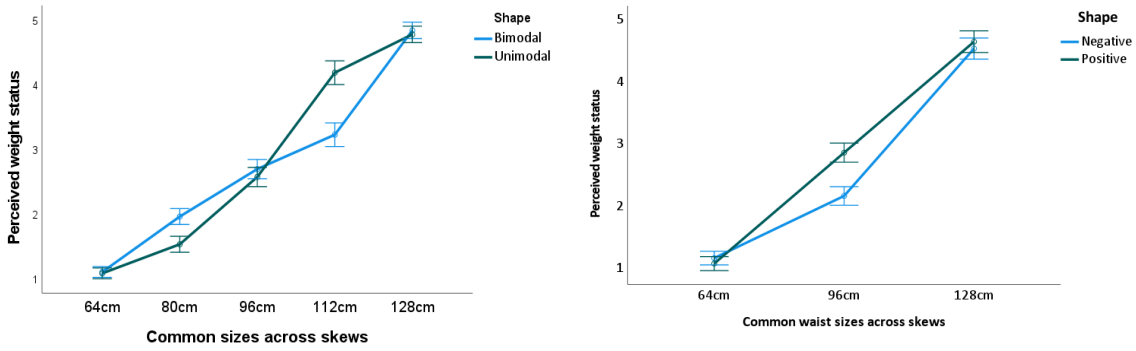
2.69, *SD* = 0.55) and waist size 128cm (Unimodal: *M* = 4.78, *SD* = 0.47); Bimodal: *M* = 4.84, *SD* = 0.43).

Next we compared waist size 80cm (rank 2nd in the unimodal distribution vs 5th in the bimodal distribution). In line with the rank principle, participants perceived waist size 80cm to be more overweight in the bimodal distribution (rank 5th) (*M* = 1.96, *SD* = 0.29) than in the unimodal distribution where it ranked lower (rank 2nd) (*M* = 1.53, *SD* = 0.55).

We compared waist size 112cm (rank 10th unimodal vs rank 7th bimodal) participants perceived waist size 112cm to be more overweight in the unimodal distribution (M = 4.18, SD = 0.67) where it ranked higher (rank 10th) compared with the bimodal distribution where it ranked lower (rank 7th) (*M* = 3.22, *SD* = 0.62).

A 5 (within: common waist size) x 2 (between: distribution) mixed ANOVA showed there was a significant main effect of common waist size, $F(4, 93) = 1154.617$, $p < .001$, partial eta squared=.980. There was no significant main effect of distribution on weight judgements, $F(1, 96) = 1.233$, $p < .27$, partial eta squared= .013. There was a significant common waist size by distribution interaction, $F(4, 93) = 27.50$, $p < .001$, partial eta squared= .542 suggesting that the weight judgment of figures were dependant on the rank of that figure within each condition.

Figure 24 *Perceived weight judgements of figures with common waist sizes by distribution type (Bimodal vs Unimodal on left and Negative vs Positive on right). Error bars represent 95% confidence intervals*



*Perceived weight status 1=underweight, 2=healthy weight, 3=overweight, 4=obese, 5=severely obese.

The figures above show the common waist sizes across the distribution of figures (Bimodal/Unimodal and Negative/Positive) and perceived weight judgement of figures. An example, graph on the right shows that when figures with the same waist size (96cm) were ranked differently in different distributions, the weight of the same figure (96cm) was judged as a smaller weight in the negative distribution compared to the positive distribution. Graph

on the left shows when common waist size (96cm) ranked in same position across distributions, participants judged the figures weight similarly.

Table 25 *Means and standard deviations for perceived weight relating to five different figures, by unimodal and bimodal group.*

Common point	Waist size	Unimodal rank	Bimodal rank	Unimodal mean	Bimodal mean	*t*	*p*
1	64	1st	1st	1.08(sd=.28)	1.10(sd=.31)	-0.35	.73
2	80	2nd	5th	1.53(sd=.55)	1.96(sd=.29)	-4.88	.01
3	96	6th	6th	2.57(sd=.50)	2.69(sd=.55)	-1.16	.25
4	112	10th	7th	4.18(sd=.67)	3.22(sd=.62)	7.37	.01
5	128	11th	11th	4.78(sd=.47)	4.84(sd=.43)	-0.68	.50

Comparing objective weight status of common figures with participants perceived weight status

For each of the common waist sizes across the two distributions, we compared the objective weight status with participants perceived weight status (see table 26 for further details). For waist size 64cm (rank 1st) and waist size 128cm (rank 11th) most participants judged the weight status of the figures correctly. However, this was not the case for waist size 80cm and waist size 112cm. For waist size 80cm (rank 2nd in the unimodal distribution vs rank 5th in the bimodal distribution) a significantly higher proportion of participants (49%) in the unimodal skew underestimated the healthy weight figure by (incorrectly) judging it as underweight compared with 6.3% in the bimodal skew. For waist size 112cm (rank 10th in the unimodal distribution vs rank 7th in the bimodal distribution) a much higher proportion of participants underestimated the weight of the obese figure in the bimodal distribution, 68.8% of participants (incorrectly) judged the figure as overweight compared to the unimodal distribution (14.3%).

Table 26 *Comparison of objective weight status with the participants perceived weight status for common waist sizes in unimodal and bimodal distributions*

Waist size (cm)	Actual Weight status	Subjective Weight status (Unimodal)	Subjective weight status (Bimodal)
64	Underweight	Underweight (91.8%), Healthy (8.2%)	Underweight (91.7%), Healthy (8.3%)
80	Healthy weight	Underweight (49%), Healthy (49%), Overweight (2%)	Underweight (6.3%), Healthy (91.7%), Overweight (2.1%)
96	Overweight	Healthy (42.9%), Overweight (57%)	Healthy (33.3%), Overweight (62.5%), Obese (4.2%)
112	Obese	Overweight (14.3%), Obese (53.1%), Severely Obese (32.7%)	Healthy (6.3%), Overweight (68.8%), Obese (20.8%), Severely Obese (4.2%)

128	Severely Obese	Overweight (2%), Obese (18.4%), Severely Obese (79.6%)	Overweight (2.1%), Obese (12.5%), Severely Obese (85.4%)

Positively and negatively skewed distributions

We compared the mean ratings for common waist sizes that were ranked in the same position across positively and negatively skewed distributions (figure 24). Table 27 (below) shows comparisons of the mean weight judgement for the positively and negatively skewed groups across each common point, reporting independent samples *t*-test and *p*-value.

Waist sizes 64cm (rank 1st) (Positively skewed distribution: *M* = 1.08, *SD* = 0.27; Negatively skewed distribution: *M* = 1.17, *SD* = 0.51) and 128cm (rank 11th) (Positively skewed distribution: *M* = 4.65, *SD* = 0.48); Negatively skewed distribution: *M* = 4.54, *SD* = 0.75) were perceived similarly across the two distributions.

Next, we compared the mean rating for waist size 96cm (rank 4th in the negatively skewed distribution vs rank 8th in the positively skewed distribution). In line with the rank principle, participants perceived waist size 96cm to be more overweight in the positively skewed distribution (*M* = 2.86, *SD* = 0.60) where it ranked higher (rank 8th) than in the negatively skewed distribution where it ranked lower (rank 4th) (*M* = 2.17, *SD* = 0.51).

A 3 (within: common waist size) x 2 (between: distribution) mixed ANOVA showed there was a significant main effect of common waist size, $F(2,102) = 999.867$, $p < .001$, partial eta squared = .95. There was a significant main effect of distribution on weight judgements, $F(1,103) = 15.10$, $p = .001$, partial eta squared = 0.128. There was a significant common waist size by distribution interaction, $F(2, 102) = 29.287$, $p < .001$, partial eta squared = .365, the rank position of the figure in different contexts influences weight judgements.

Table 27 *Means and standard deviations for perceived weight relating to five different figures, by positively and negatively skewed group.*

Common point	Waist size	Positively skewed rank	Negatively skewed rank	Positively skewed mean	Negatively skewed mean	*t*	*p*
1	64	1st	1st	1.08(sd=.27)	1.17(sd=.51)	-0.10	.26
2	96	8th	4th	2.86(sd=.60)	2.17(sd=.51)	6.41	.01
3	128	11th	11th	4.65(sd=.48)	4.54(sd=.75)	0.90	.37

Comparing objective weight status of common figures with participants perceived weight status

For common figures across distributions, we compared participants perceived weight status with the objective weight status (see table 28 below). For waist size 64cm (rank 1st) most

participants correctly judged the figure to be underweight. Likewise, for waist size 128cm (rank 11th), two thirds of participants correctly judged it to be severely obese.

The effects of rank can really be demonstrated for waist size 96cm (rank 4th in the negatively skewed distribution vs rank 8th in the positively skewed distribution) which is objectively classed as overweight. When the same figure ranked higher in a sample (positively skewed distribution), two thirds of participants correctly identified it as overweight (62.7%). Whereas the same waist size presented in the negatively skewed distribution (where it ranked much lower in the distribution), most participants underestimated the figure to be 'healthy weight' (87%).

Table 28 *Comparison of objective weight status with the participants perceived weight status of the each of the common waist sizes in positive and negatively skewed distributions.*

Waist size (cm)	Objective weight status	Subjective weight status (Positively skewed)	Subjective weight status (Negatively skewed)
64	Underweight	Underweight (92.2%), Healthy (7.8%)	Underweight (87%), Healthy weight (11.1%), Obese (1.9%)
96	Overweight	Healthy (25.5%),Overweight (62.7%) Obese (11.8%)	Healthy weight (87%), Overweight (11.1%), Severely Obese (1.9%)
128	Severely Obese	Obese (35.3%),Severely Obese (64.7%)	Healthy weight (3.7%), Overweight (3.7%),Obese (27.8%), Severely Obese (64.8%)

6.10. General Discussion

The results of two experiments support the hypothesis that people's judgements about the weight of others are influenced by the comparison context. More specifically, results show that participants' judgments are influenced by the rank position of a given stimuli (here waist size of a figure) among other comparison stimuli. The difference in judgments for common sizes between the bimodal and unimodal conditions also refute a model in which people's judgments could be explained by the sensitivity to the mean of the comparison sample.

Both studies demonstrate that perceptions of weight can be experimentally manipulated by shifting the rank position of a given body weight, and therefore changing the comparison context. This is important as the findings have wider implications for reference group composition. For example, if people base their weight judgements on small or unrepresentative samples, they are likely to form biased judgements towards their weight which can have implications for their behaviour and health. In study 4, figures with common waist sizes across distributions were judged significantly differently depending on where they ranked within a sample. Study 5 replicated the exact same findings, however demonstrated

that the effect still holds true when asking people to judge the weight of figures using descriptive weight categories (e.g., obese).

In study 5, we compared the discrepancy between objective weight status and perceived weight status of the common figures across distributions. When comparing common waist sizes across conditions, it appeared that participants tended to underestimate the weight of the figures in certain contexts. For example, waist size 80cm, which ranked 2nd in the unimodal distribution and 5th in the bimodal distribution was underestimated by half of participants in the unimodal group as underweight instead of healthy weight. Likewise, common waist size 112cm (rank 7th bimodal and 10th unimodal) was perceived as overweight by two thirds of participants instead of obese in the bimodal distribution. Similarly, for the positively and negatively skewed distributions, common waist size 96cm (rank 4th in the negatively skewed distribution vs 8th in the positively skewed distribution) was underestimated by most participants in the negative distribution as healthy weight instead of overweight.

The results support previous literature by demonstrating the importance of social rank and context when making a judgement (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Wood et al., 2011). The two studies presented in this paper are novel in that they extend the importance of rank-based judgment in the context of how people make a weight judgement. Importantly, the findings offer an alternative explanation to visual normalisation theory which suggests people use an 'internal average' to make a weight status judgement (e.g., Oldham & Robinson, 2017; Robinson, 2017; Robinson & Kersbergen, 2017).

Our results demonstrate that body weight judgements depend on the context in which the judgement is being made. Although not the focus of the paper, we did find that people underestimated the weight status of figures with overweight and obesity (study 5). This result is in line with previous research reporting underestimation of overweight and obesity (e.g., Johnson et al., 2014a; Muttarak, 2018; Oldham & Robinson, 2015; Oldham & Robinson, 2017; Yaemsiri et al., 2011). However, the present study provides evidence that people are sensitive to where a figure ranks in sample and use this information to inform their judgement. This is important to consider in the context of obesity in society and the reference group that people use when making a weight judgement. Research suggests that underestimation of the weight status of others with overweight or obesity is more likely to occur in geographical areas where obesity is more common (Binkin et al., 2013; Robinson & Hogenkamp, 2015). This effect has also been demonstrated for personal weight status for example in school settings and among friendships. For example, research suggests that people with overweight or obesity are more likely to underestimate their weight if their friends and/or peers are overweight and/or obese (e.g., Brown et al., 2010; Maximova et al., 2008; Ramirez & Milan, 2016). However, rank may

explain these effects as opposed to people using an 'internal' average of weight. The findings of this study suggest it may be beneficial to inform people of where they rank relative to others (e.g., in the UK population or a specific age group) to correct beliefs about the social distribution. Our findings may also have clinical implications for professionals working in weight management. Individuals with obesity might benefit from an intervention that informs them of where they objectively rank with others compared to their subjective rank. Previous research has suggested that key people in society such as medical professionals underestimate the weights of patients with overweight and obesity (e.g., Ahern et al., 2012; Robinson et al., 2014). It would therefore be interesting to replicate the present study with medical professionals and compare these findings to a lay person group, as it is crucial that those working in healthcare recognise when an individual is overweight or obese and needs to make lifestyle changes.

In the present studies, participants judged the weight of *male* 3D figures, which is important as previous research has found that people are likely to underestimate the weight of men with overweight and obesity (e.g., Oldham & Robinson, 2015; Oldham & Robinson, 2017; Robinson & Hogenkamp, 2015). However, future research should replicate this study using 3D figures of females. Given that females are most likely to incorporate other females in their weight reference group when making a personal weight judgement, it would be particularly interesting to explore females' weight judgments of other females (Clohessy et al., 2021a). A strength of this study is that the 3D figures were created using a programme that utilised real world BMI scores. We created the 3D figures based on the height of an average male in the UK, this enabled us to control for height and calculate BMI scores. A limitation is that most participants identified as White. Previous research suggests that underestimation of overweight and obesity is common in specific ethnicities e.g., Black, Hispanic, South Asian (Bhanji et al., 2011; e.g., Brug et al., 2006; Chang & Christakis, 2003). Therefore, it would be worthwhile to replicate the present study using a more diverse group of participants. Indeed, research suggests that people in South Asian populations are more susceptible to type 2 diabetes (Narayan & Kanaya, 2020). Given that a high BMI score is a contributing factor towards type 2 diabetes, accurate weight perception is an important determinant of weight loss and thus individuals overall health (Bhanji et al., 2011; Wainberg et al., 2019).

6.11. Conclusion

In summary, the studies tested whether the weight of 3D figures with common waist sizes were judged differently depending on where they ranked in a sample. In both studies, the weights of common figures (with the waist sizes) across different distributions were underestimated in certain contexts. The findings are consistent with research exploring rank

across various domains, suggesting that people use rank to make a judgement and do not rely on the mean. The findings offer a novel contribution by explaining the cognitive mechanisms by *how* people make these often (incorrect) judgements towards weight.

6.12. Chapter 6 Summary

This chapter reported on the findings of studies 4 and 5 which began with aims and objectives for chapter six. Then, the context of the two studies were discussed in relation to the findings of chapter five (studies 1, 2 and 3). The abstract and an introduction for studies 4 and 5 was then provided. Following this, the findings of studies 4 and 5 presented. Next, a general discussion of both studies which compared the findings to existing literature, considered the implications of the findings and limitations of the studies. Judgments of weight in context appear to be sensitive to the rank position of one's weight relative to the weights of others. These results lend further support to rank-based models of human judgment and offer insight into the exact mechanisms by which people judge weight of themselves and others. Studies presented in the next chapter will investigate judgements about eating behaviours in different reference groups.

Chapter 7: Perceptions of restrained eating across reference groups in a non-clinical female sample

7.1. Chapter 7 Overview

This chapter reports on the findings of studies 6 and 7 which begins with aims and objectives for chapter five. Then, the context of the two studies will be discussed in relation to the findings of chapter five (studies 1, 2 and 3) and chapter six (studies 4-5). The abstract and an introduction for studies 6 and 7 is then provided. Following this, the findings of studies 6 and 7 are presented. Next, a general discussion of both studies which compares the findings to existing literature, considers the implications of the findings and limitations of the studies, followed by a chapter summary.

7.2. Aims

- To test a rank-based approach as an underlying mechanism to explain people's *judgements* towards their restrained eating **(study 6)**
- To test a rank-based approach as an underlying mechanism to explain people's perceived *worry* towards their restrained eating **(study 7)**

7.3. Abstract (Studies 6 and 7)

Title: Perceptions of restrained eating norms across reference groups in a non-clinical female sample

Aim: To test whether perceptions of other females' restrained eating influences participants' judgements (e.g., worry) towards their own restrained eating.

Methods: In study 6 women provided information on (a) their own levels of restrained eating behaviour (in exact days) (b) their perceptions of restrained eating in the UK population and an Instagram population, and (c) their judgements to the extent to which they engage in restrained eating. Study 7 surveyed females who provided information on (a) their own levels of restrained eating (b) their perceptions of restrained eating in the UK population and Instagram (c) their perceived level of worry towards their restrained eating.

Results: Study 6 found that rank of restrained eating did not predict judgements towards levels of own restrained eating. Study 7 found no difference between beliefs of social distribution of restrained eating in either Instagram and UK population.

Conclusion: This study utilised a novel methodology to elicit perceptions of restrained eating in two different distributions. The study found no differences in perceptions of restrained eating per month between the reference groups. Future research could explore alternative methods to understand social norms of eating behaviours within reference groups.

7.4. Introduction

Perceptions of other people's eating behaviours have been found to influence *what (*e.g., type of food consumed) and *how* much is consumed (e.g., Lake et al., 2016; Prinsen et al., 2013; Robinson et al., 2013; Thomas et al., 2017). Perceived social norms regarding the eating behaviour of office colleagues influences *what* food is consumed at work (Clohessy et al., 2019). For example, employees have reported feeling pressured into consuming unhealthy meals with their colleagues (e.g., Clohessy et al., 2019; Lake et al., 2016; Payne et al., 2013). One study exposed employees to a descriptive norm message, *"Most people here choose to eat vegetables with their lunch".* The intervention was positively associated with the percentage of meals purchased with vegetables, even after a 6 week delay (Thomas et al., 2017).

Perceptions of social norms have also been studied in relation to *disordered eating* (Gerbasi et al., 2014). For example, one study investigated the beliefs of adolescent girls about the prevalence of dieting and disordered eating behaviours among same sex friends and school peers (Gerbasi et al., 2014). They found a positive association between perceived peer norms relevant to disordered eating behaviours with greater levels of individual eating psychopathology. For example, participants who perceived a higher level of peer engagement in dieting and disordered eating among same sex friends scored higher on levels of eating psychopathology (EDE-Q). Additionally, another study by Forney and Ward (2013) measured perceptions of descriptive and injunctive norms in relation to disordered eating in non-clinical college women. They found that body dissatisfaction was associated with greater disordered eating when females perceived their friends as approving of disordered eating norms (e.g., *"my friends think using laxatives is an acceptable way to lose weight"*). Taken together, these studies suggest that social norms in relation to disordered eating are influential on females own disordered eating behaviours.

More recently, perceived norms and eating behaviours have been investigated in the context of social media. One study reported that perceived norms of Facebook users' consumption of fruit and vegetables was associated with participant's own self-reported fruit and vegetable consumption (Hawkins et al., 2020). Therefore, individuals people follow on social media platforms might be an important reference group for eating behaviours (Hawkins et al., 2020). Research has shown that social media users often use platforms such as Instagram as a source of nutritional information (Moorman et al., 2020). In recent years, uploading posts relating to healthy eating on social media has become increasingly popular (Pilař et al., 2021). Consequently, this has the potential to create healthy eating norms for people to follow (e.g., consumption of fruit and vegetables). However, using social media as a

source of nutritional advice has been associated with greater disordered eating (Moorman et al., 2020). Furthermore, more generally research suggests that time spent using social media is associated with disordered eating behaviours (e.g., restrictive diets) especially among females (e.g., Holland & Tiggemann, 2016; Moorman et al., 2020; Turner & Lefevre, 2017; Wilksch et al., 2020). This is important because research suggests that relevant eating norms are set by similar others and by people we identify with (Higgs, 2015). Instagram is a predominantly image-based social platform compared with text-based platforms such as Twitter. Given this, it is possible that Instagram users feel a stronger connection to people they follow and therefore may be more likely to take advice or copy other people's diets on the platform (Turner & Lefevre, 2017). Furthermore, it has been suggested that social media use may contribute to an 'echo-chamber' effect, with individuals following likeminded others. As a result, users of social media may perceive their beliefs and behaviours to be more common than they actually are (Salathé & Khandelwal, 2011). In the context of disordered eating behaviours, this may lead people to perceive a higher prevalence of a given behaviour such as restrained eating.

One method used to understand people's beliefs about social norms is to elicit distributions of a given behaviour (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Melrose et al., 2013). A distribution can be defined as a frequency of a given behaviour in a specific reference group (e.g., UK population). Unlike summary statistics such as the mean of a sample, the distribution can inform us about the prevalence at different levels of a given behaviour (e.g., the top 1% of people in the UK earn 175, 000 per year). People utilise the distribution to form views about the social norm. In turn people often use their beliefs about the social norm to make a judgement. However, often people's judgements are incorrect as a direct result of misperceived norms. For example, a study found that judgements about an individual's own levels of anxiety and depression are not based on frequency of symptoms, but by where participants ranked the severity of their symptoms in comparison with their believed symptoms of others (Melrose et al., 2013). Relative rank is a key component of the *Decision by Sampling theory* (DbS) which suggests that a subjective value of a stimulus is based on a series of binary, ordinal comparisons in a memory sample (Stewart et al., 2006). In the context of social judgments, several studies have reported that people are sensitive to the relative rank position within a comparison group, and this is true over and above an absolute quantity (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Maltby et al., 2012; Wood et al., 2011). Applied to restrained eating, an individual who is high in restrained eating may believe that many other people also engage in this behaviour and therefore may not perceive their behaviour as problematic. Study 2 (chapter 5) reported in this thesis found that female participants were most likely to include other females in their reference group when ranking

their weight in comparison to other people. Given that research has found that females are more likely to engage in restrained eating, this study will focus on females only (Jastreboff et al., 2014).

In summary, social norms research has focused on how other people influence *what and how* much we eat (e.g., Prinsen et al., 2013; Thomas et al., 2017). Less attention has been given to perceived norms regarding disordered eating cognitions and behaviours such as restrained eating. Instagram use is associated with restrained eating and has been highlighted as a key reference group for eating behaviours (e.g., Hawkins et al., 2020; Wilksch et al., 2020). However, it is unclear how norms regarding restrained eating are perceived among Instagram and in the UK population and whether these beliefs affect participants' judgements towards their own restrained eating. Previous research has suggested that people's subjective judgements are influenced by where they rank themselves within a sample (e.g., Maltby et al., 2012; Wood et al., 2011). However, relative rank has not been tested in the domain of disordered eating. Therefore, the present studies explored the perceptions of social norms in relation to restrained eating of females across two key reference groups. Specifically, the aim of the studies was to test a rank-based approach as an underlying mechanism to explain people's judgements towards their own restrained eating. Study 6 elicited participants' beliefs of the social distribution of two reference groups. We then calculated participant rank of restrained eating behaviours within each reference group and used this to predict participants judgement about their own eating behaviours. Study 7 again explored beliefs about the social distribution in two reference groups, we investigated whether participants rank of their own restrained eating within the reference groups predicted participants worry with their disordered eating.

7.5. Study 6 Methods

In study 6, female participants were asked to estimate the extent to which females in two different reference groups engage in restrained eating. We investigated whether perceived prevalence of restrained eating in females on a) Instagram and among b) females in the UK population predicts participants own perceived levels of restrained eating.

Study 6 Pre-screener questionnaire

A total of 463 participants completed a pre-screener study via the online recruitment platform Prolific (https://www.prolific.co/). To be eligible for the study, participants needed be female, over 18 years old, not be a current student and live in the United Kingdom. Eligible participants accessed the questionnaire via an online survey platform Qualtrics (https://www.qualtrics.com/uk/). Due to the sensitive nature of the questionnaire, the pre-screener contained information about the study and detailed clearly what the questions would

involve; participants were asked two questions, *"Are you currently receiving, or have previously received, psychological and / or medical treatment for an eating disorder or other related condition?"* (Yes, no, I'd prefer not to say) and *"Do you have an Instagram account?"* (yes/no), all participants were rewarded £0.25 for taking part (equivalent of £7.50 per hour). Participants with no history of eating disorders and an Instagram account were eligible to take part in the main study (*N* = 340). All participants were debriefed after taking part and due to the sensitive nature of the questions in the pre-screener questionnaire, participants were provided with links to resources for help with disordered eating such as signposting to the eating disorders charity BEAT.

Study 6 main study

A total of 146 participants were recruited to take part in the main study via Prolific and accessed the survey via Qualtrics, seven participants' data were removed as their distribution data could not be analysed. 139 participants' data were analysed, female participants were aged between 19 and 71 (*M* = 33.45, *SD* = 9.69). The mean body mass index was 26.6 (*SD* = 7.0), the BMI scores within the sample were slightly below the UK average of 27.7 (Health Survey for England, 2017). Six were underweight (4%), 58 were healthy weight (42%), 45 were overweight (32%), 24 were obese (17%) and 6 severely overweight (4%), BMI scores were calculated using categories reported in the Health Survey for England (2017). Participants followed an average of 407 accounts on Instagram each. This research was approved by the University of Warwick's Biomedical and Scientific Research Ethics Sub-Committee (approval BSREC REGO-39/20-21). A number of ethical issues were considered ahead of data collection, all of which were approved in the University of Warwick ethics application. Firstly, before taking part in the study, all participants were given an information sheet, which set out clearly what the study would entail. For example, participants were informed that they would be asked questions about their eating behaviours and the eating behaviours of others (e.g., people on their Instagram account) and informed they would be asked to disclose their body weight. Secondly, as described above a pre-screener was used to ensure that participants with a history of eating disorders could not take part in the study. Thirdly, participants who did take part in the study were presented with a debriefing sheet at the end of the study. Due to the sensitive nature of the questions in the questionnaire, participants were provided with links to resources for help with disordered eating such as signposting to the eating disorders charity BEAT.

Study 6 Procedure

Following informed consent, participants were randomly counterbalanced to one of two versions of the questionnaire which differed only in presentation of items. Participants completed questions either in section one or section two first. In section one questions related

to self-reporting of participants own restrained eating (*n* = 76 answered section one first). In section two questions elicited distributions about restrained eating behaviours of others (*n* = 77 answered section two first).

Section one

Self-reported days engaging in restrained eating per month. To provide a simple, yet established assessment of frequency of restrained eating behaviours, participants answered the relevant behaviour question taken from the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994) *'On how many of the past 28 days...have you engaged in restrained eating (e.g., deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?'* As per the original measure, participants selected the number of days from a drop-down list, ranging from no days to 28 days. We asked participants to think about their eating behaviours over the previous 28 days. This time frame was selected as the EDE-Q restraint scale questions asks participants about their eating behaviours over a 28-day period. In order to increase the face validity of the data, after the behavioural measure of self-reported restrained eating we provided an example of restrained eating, using the wording taken from question one of the restraint scale on the EDE-Q to demonstrate what restrained eating is *'deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)'* (Fairburn & Beglin, 1994). We selected the wording from question one of the EDE-Q as restrained eating definition because we believed it encapsulated restrained eating the most out of the five questions of the restraint scale on the EDE-Q.

***Perceptual measure of restrained eating*.** Participants were also asked *'To what extent do you perceive that you engage in restrained eating? e.g., deliberately limiting the amount of food you eat, to influence your shape or weight.'* scored on a seven-point scale from not at all to definitely. Here, we used the same example from the EDE-Q (question one) to provide an example demonstrating restrained eating.

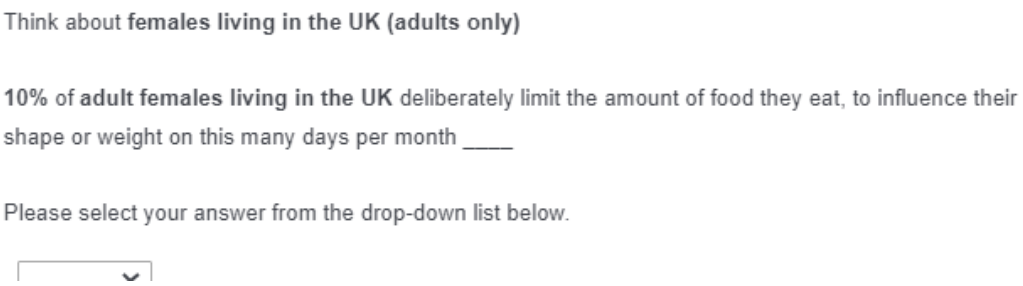
The two questions in section one were presented in a randomised order.

Section two

Distribution elicitation of restrained eating in UK population (females). Participants answered nine questions of a distribution elicitation task. This aimed to determine participants beliefs about the distribution of restrained eating among other females in the UK. This method has been used previously and successfully in studies eliciting perceptions in other domains (see Aldrovandi et al., 2015b; Wood et al., 2011). The question was phrased as follows: *'Think about females living in the UK (adults only). **X**% of adult females deliberately limit the amount of food they eat to influence their shape or weight on this many days per month ____ Please*

select your answer from the drop-down list below' (where **X** had values of 10, 20, 30, 40, 50, 60, 70, 80 and 90) (see figure 25 below) Answer options ranged from no days to 28 days. Each question required participants to estimate the number of days per month they believed other females deliberately limit the amount of food they eat. All percentage questions were randomised for each participant.

Figure 25 *Question eliciting distribution of restrained eating in females in UK population*



Distribution elicitation of restrained eating on Instagram (females). Participants repeated the same task as above, however this time they were instructed to think about adult females they follow on their Instagram account (see appendix 9 for figure). Participants were randomised to either answer questions about Instagram or UK population first.

Section three

Eating, shape and weight concerns. The EDE-Q is a 36-item self-report measure of eating psychopathology and has been validated against the Eating Disorder Examination interview (Fairburn & Beglin, 1994). It contains 22 items reflecting pathological eating attitudes, divided into four scales: weight concern, shape concern, eating concern and restraint, sub-scales and a global score can be calculated. The EDE-Q has been shown to be reliable and valid for use in non-clinical groups (Carey et al., 2019). Frequencies of eating-disordered behaviours are assessed in terms of the number of episodes occurring in the past 4 weeks. Higher scores on the EDE-Q (on the global EDE-Q score and sub-scales) indicate a greater level of eating psychopathology, i.e., denoting more problematic eating behaviours and attitudes. The EDE-Q was chosen for use in this study because it is a widely used measure of eating disorder psychopathology and subscale scores reflect the severity of characteristics of eating disorders. Using the EDE-Q provided an indication of participants tendency to engage in restrained eating behaviours via the dietary restraint sub-scale. In terms of the restraint sub-scale, individuals are asked about their restraint behaviours in five questions all ask for number of days 0-28 they have engaged in the behaviour. To calculate restraint sub-scale all 5 items are added together and then divided by five. Dietary restraint has been implicated as a risk

factor for the development of eating disorders (Racine et al., 2011). In the present study, reliability (α) was high, Dietary restraint EDE-Q = .95, Global Score=.88.

Instagram usage*.* Instagram usage was assessed using questions adapted from a questionnaire by Slater et al. (2017). Participants answered questions about how much time per day they spend on Instagram, the number of accounts they follow, how often they post pictures to the platform.

Self-reported height and weight*.* To calculate BMI, participants provided self-reported weight (kilograms or stone and pounds) and height (cm or feet and inches).

Demographics. Participants answered questions about age and ethnicity. On completion, participants were debriefed on the purpose of the study and signposted to a series of resources they could access for advice about disordered eating (e.g., BEAT).

7.6. Study 6 Results

Data analysis

To calculate the rank position of each participant within what they believed to be the distribution of restrained eating in a) females they follow on Instagram b) females in the UK population, a normal distribution was fitted separately for each participant to the nine questions eliciting their beliefs about each distribution. For each participant, we then calculated the relative rank position of each participant's self-reported exact days engaging in restrained eating (0-28 days) within their distribution of restrained eating in a) females on Instagram b) females in the UK population. We then used participants ranked position to explore if it predicted participants' judgements towards their own level of restrained eating in a multiple regression (see table 30). Seven participants were removed from the data analysis because they provided a zero to every answer of the distribution for Instagram, and therefore a distribution could not be fitted.

Results

Table 29 *Means and standard deviations for Eating behaviours and Instagram measures*

Measure	N=139
Self-report restraint (0-28 days)	M=8.48, SD=9
Shape Concern	M=2.8, SD=1 .6
Weight Concern	M=2.5, SD=1.5
Restraint	M=1.4, SD=1.3
Global EDE-Q score	M=1.9, SD=1.3
Time spent on Instagram each day	
No time	5 (3.6%)
Less than 10 min	33 (23.7%)
10-30 min	31 (22.3%)
30-60 min	34 (24.5%)

Over an hour	36 (25.9%)
How often post pictures	
Never	22 (15.8%)
Less than once a month	69 (49.6%)
Once a month	18 (12.9%)
2-3 times per month	24 (17.3%)
Daily	6 (4.3%)

Table 30 below shows a correlation matrix between variables of interest. Both measures of restrained eating (self-reported days, and dietary restraint scale from EDE-Q) were highly correlated with perception of their own restrained eating. This suggests that people with higher EDE-Q scores eating also perceived their restrained eating as higher.

Table 30 *Pearson (r) correlation matrix between predictor and outcome variables*

	Perception restraint	Instagram rank	Population rank	Exact days restraint
Restraint(EDE-Q)	.70**	.59**	.59**	.76**
Perception restraint	X	.42**	.48**	.68**
Instagram rank		X	.78**	.68**
Population rank			X	.70**
Exact days restraint				X

** Correlation is significant at the 0.01 level (2-tailed).

A series of linear multiple regressions were used to examine whether participants rank scores predicted their perceptions of their own restrained eating. We ran three models, one with exact days of restrained eating (Model A), a second with the addition of Instagram rank (Model B) and a third with addition of population rank (Model C). All models include age and BMI as covariates (see table 31 below).

Exact days predicting perceptions of restrained eating (Model A). Variables entered into Model A significantly predicted participants own perception of restrained eating ($p < .01$). Exact numbers of days of restrained eating reported over a 28-day period predicted their perception of restraint.

Table 31 *Multiple regression models reporting standardised coefficients (β) for the analyses on predictor variables (BMI self-reported, perceived self-reported rank of weight) towards outcome variables (weight status, overweight risk)*

		Adj R^2	β	*p*
Model A	Age	.44	.01	.86
	BMI (self-reported)		.04	.49
	Exact days		.67	**.01**
Model B	Age	.44	.01	.99
	BMI (self-reported)		.04	.53
	Exact days restraint		.72	**.01**
	Instagram restraint rank		-.08	.40
Model C	Age	.44	.11	.86
	BMI (self-reported)		.05	.49
	Exact days restraint		.66	**.01**
	Population restraint rank		.03	.77

Note. All models control for age; β = standardized regression coefficient.

Instagram rank predicting perceptions of restrained eating (Model B). Instagram rank was added into the model, variables entered into Model B significantly predicted participants own perception of restrained eating ($p < .01$), Instagram rank was not a significant predictor here, but exact days engaging in restrained eating reported over a 28-day period was a significant predictor.

Population rank predicting perceptions of restrained eating (Model C). This time population rank was added into the model, variables entered into Model C significantly predicted participants own perception of restrained eating ($p < .01$). Population rank was not a significant predictor here but exact numbers of days of restrained eating reported over a 28-day period was a significant predictor.

It is possible that the effects of the rank variables may have been absent because of multicollinearity. All predictor variables were entered into a linear regression to obtain collinearity statistics. All tolerance values were greater than or equal to 0.33 (perception of restrained eating: age = .90, BMI = .96, exact days of restrained eating = .44, Instagram rank = .34, Population rank = .33, therefore multicollinearity does not appear to be an issue. One explanation of the results could be due to a non-clinical group of participants, therefore overall levels of restrained eating were not that high in this sample. To investigate this, we excluded participants who reported zero days on the self-reported question of restrained eating per

month. We then repeated the multiple regression models above, but rank scores remained non-significant predictors.

7.7. Study 6 Discussion

This study aimed to investigate whether participants perceived norms of restrained eating in females they follow on Instagram and females in the UK population predicts participants judgements towards their own levels of restrained eating. The results revealed that, as would be expected, self-reported exact days per month that participants engaged in restrained eating predicted their perceived level of restrained eating. However, where participants own restrained eating behaviour (exact days per month) ranked amongst the Instagram distribution and among the distribution of UK population were non-significant predictors. This result is surprising given that hundreds of previous studies across domains have demonstrated that rank effects are important for subjective judgements, including body weight judgements (e.g., Aldrovandi et al., 2015a; Boyce et al., 2010; Clohessy et al., 2021b; Melrose et al., 2013; Moore et al., 2016; Wood et al., 2011).

One explanation of the results is that participants may have interpreted restrained eating in different ways and researchers have recently discussed this (Polivy et al., 2020). Using the definition from the EDE-Q restraint sub-scale, from this studies perspective restrained eating is viewed as problematic, indeed, research suggests that restrained eating can be an indicator of prospective eating disorders such as binge eating (Schaumberg et al., 2016b). The present study defined restrained eating as attempts at restrictive eating to influence one's weight or shape, regardless of actual success. It is possible that participants restrict their food everyday by monitoring calorie intake and eating reduced portion sizes in order to influence their weight and shape. These are examples of restrictive eating that may not necessarily be viewed as negative eating behaviours. Indeed, there is a difference between people with clinically significant restricted eating and those whose restrict eating in order to maintain their weight and shape (e.g., reducing intake of foods high in sugar which is actively encouraged by health professionals and public health campaigns) (Lamport et al., 2021; Schaumberg et al., 2016b). The present study used the sub-scale EDE-Q to measure restrained eating, the five items on the scale measures the frequency of days per month that someone engages in restrained eating such as 'Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?'. To offer participants more clarity on what is meant when referring to restrained eating, future research could provide a definition of restrained eating at the beginning of the study with further examples taken from the EDE-Q restraint subscale such as *'Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?'*.

Another explanation of the non-significant results is that the perceptual measure of restrained eating and the self-reported exact days question were highly correlated. This may be because although there is a slight evaluative element to the perceptual question, the two questions are very similar. Previous studies exploring rank have focused on relative rank predicting a subjective judgement associated with negative consequences (e.g., Aldrovandi et al., 2015a). For example, participants in studies 1 and 2 (chapter five) ranked their body weight with others and then made a subjective judgement of their perceived risk of disease associated with overweight. In this circumstance someone might be overweight but may not rank themselves highly among others and therefore they may not perceive themselves to be at high risk of diseases (when objectively they are at risk). In study 6, restrained eating may not have been perceived negatively, study 6 should be replicated but replace the perceptual measure of restrained eating with *'how worried are you about your restrained eating?'*. Another limitation of study 6 relates to the wording of the social distribution questions (i.e., participants were asked to think of days per month that females engaged in restrained eating for differing percentiles " **X**% of adult females deliberately limit the amount of food they eat to influence their shape or weight on this many days per month ____". However, the direction of the questions was not specified i.e., there were no instructions for people to think of others who most frequently engage in restrained eating. Therefore, this was addressed in study 7, participants were asked to think of females who most frequently engaged in restrained eating (see figure 13).

7.8. Study 7 Introduction

Evidence suggests that being worried about disordered eating behaviours might lead to positive actions such as making changes or seeking support (Ali et al., 2020). Study 7 aimed to test whether people's perceptions of where their own restrained eating behaviour ranks among other women predicts how worried they are about their restrained eating. For example, high levels of restrained can be characterised by a greater number of days on which the behaviour has occurred e.g., an individual going for long periods of time (8 waking hours or more) without eating anything at all in order to influence their shape and weight and engaging in this behaviour most days out of a month would be an example of high levels of restrained eating. It is possible that someone who perceives that other woman engage in high levels of restrained eating might not be worried about their own high level of restrained eating (i.e., as it may be perceived as the 'norm'. This is important because, as a result, these individuals might be less likely to modify their behaviours or seek support or help. Study 7 followed the same methodology as study 6, except participants were provided with a more detailed definition of restrained eating (i.e., they were provided with examples taken from all five

questions that make up the 'restraint' eating scale on the EDE-Q). Participants also had to complete an attention check to demonstrate understanding of restrained eating as a concept before moving onto complete questions in the survey. As utilised in many studies testing the effects of relative rank, we inserted a diagram for each percentile question (see figure 12, left hand panel).

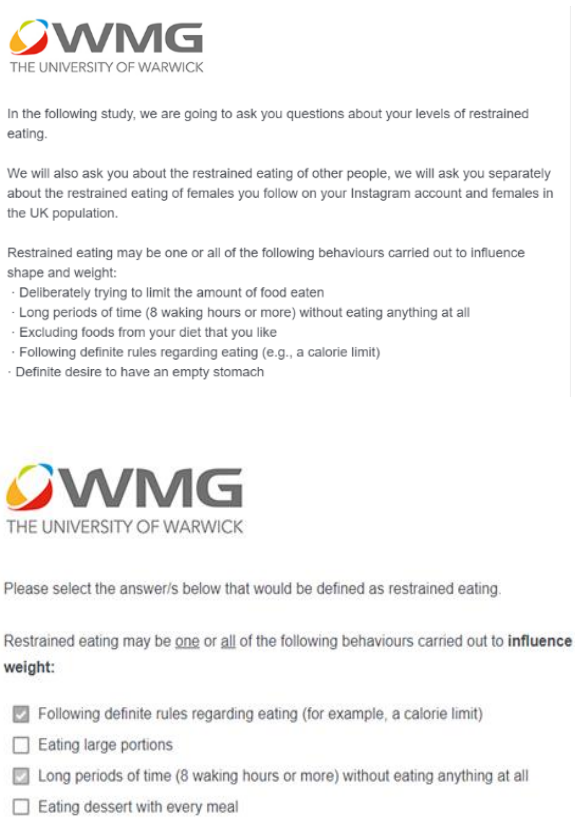
7.9. Study 7 Methods

Measures

Definition of restrained eating. Before answering any questions, all participants were shown a definition of restrained eating, participants were unable to move onto the next page of the questionnaire until a period of five seconds had passed to ensure they had read the definition (figure 26, panel on the top).

Attention check. On the next page, participants were asked to select the correct answers to what they believed constituted restrained eating (the first and third answers were correct). Once the correct answers were selected, they could complete the main questionnaire (figure 26, panel on the bottom).

Figure 26 *Definition of restrained eating with examples from the restraint scale (EDE-Q) (top panel) and attention check (bottom panel)*

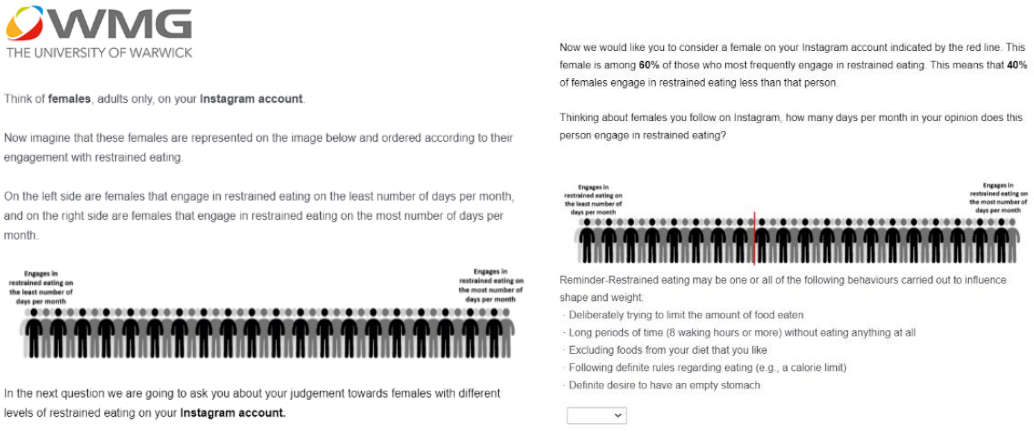


Self-reported days engaging in restrained eating per month. Participants answered the same question as study 6, however they were provided with further examples from the restraint scale on the EDE-Q. *"On how many of the past 28 days...Have you engaged in restrained eating (e.g., in order to influence your shape and weight you have… deliberately tried to limit the amount of food you eat, gone long periods of time without eating anything at all, excluded foods from your diet you like, followed definite rules regarding eating, had a definitive desire to have an empty stomach)"*. Participants selected the number of days from a drop-down list, ranging from no days to 28 days.

Level of worry about restrained eating. Participants were asked '*How worried are you about your restrained eating? (e.g., in order to influence your shape and weight you have…. deliberately tried to limit the amount of food you eat, gone long periods of time without eating anything at all, excluded foods from your diet you like, followed definite rules regarding eating, a definitive desire to have an empty stomach)'* scored from 1 [not at all] to 7 [very worried].

Distribution elicitation of restrained eating. Participants completed the same task as study 6 (detailed above) to elicit their beliefs about the social distribution of eating behaviours of females they follow on Instagram and females in the UK population. Instructions used were expanded in study 7 and a diagram (see figure 27 below) was also added to aid participants when answering the distribution elicitation questions.

Figure 27 *Instructions for the distribution elicitation task (left panel) and distribution elicitation question for Instagram (right panel)*



Participants completed the same measures as study 6 in the following order: EDE-Q, Instagram usage, self-reported height and weight and demographics. On completion of the study, participants were informed about the purpose of the study and signposted to a series of resources they could access such as advice for disordered eating.

Study 7 Pre-screener

A total of 551 participants completed a pre-screener study via the online recruitment platform Prolific (https://www.prolific.co/). We used the same pre-screener questionnaire and eligibility criteria for participants as used in study 6. 394 participants with no history of eating disorders and an Instagram account were eligible to take part in the main study, of which a total of 137 participants completed the main survey via Prolific and accessed the survey via Qualtrics.

7.10. Study 7 Results

Participants

137 female participants took part aged between 20 and 64 (*M* =38.4, *SD* = 10.5). Participants were randomised to either answer questions about the distributions first (*n* = 66) or self-reported eating behaviours (*n* = 71). The mean body mass index was 27 (*SD* = 7.15, range= 17 - 63. 3), 3 (2.2.%) were underweight, 63 (46%) were healthy weight, 39 (28.5%) were overweight, 24 (17.5%) were obese and 8 (5.8%) severely obese. A large proportion of participants identified as white British (75.9%). Participants followed an average of 379 accounts each on Instagram, see table 32 below for further participant characteristics.

Table 32 *Means and standard deviations for Eating behaviours and Instagram measures*

Measure	N=137
Self-report restraint (0-28 days)	M=9.84, SD=8.60
Restraint score	M=1.49, SD=1.27
Eating concern	M=1.12, SD=1.30
Shape concern	M=2.79, SD=1.65
Weight concern	M=2.53, SD=1.63
Global EDE-Q score	M=1.98, SD=1.31
Time spent on Instagram each day	
No time	4 (2.9%)
Less than 10 min	24 (17.5%)
10-30 min	52 (38%)
30-60 min	30 (21.9%)
Over an hour	27 (19.7%)
How often post pictures	
Never	24 (17.5%)
Less than once a month	60 (43.8%)
Once a month	28 (20.4%)

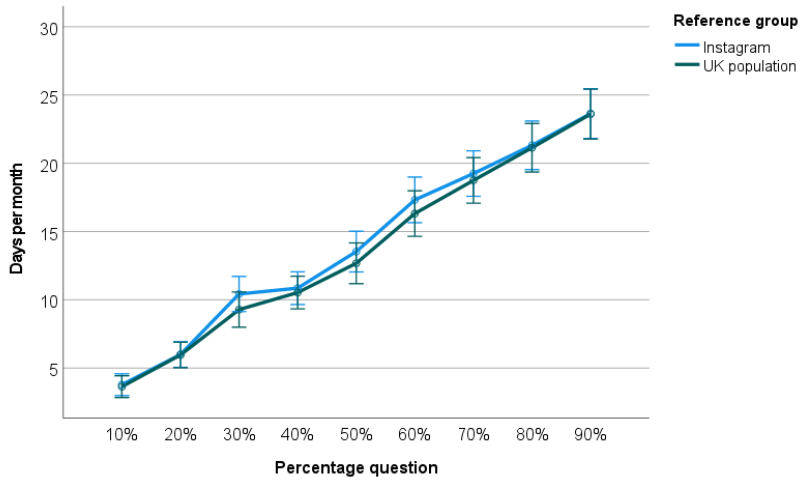
2-3 times per month	21 (15.3%)
Daily	4 (2.9%)

Data analysis

Prior to data analysis, we checked that participants had answered the distribution questions correctly. Similar to previous studies, it was expected that a small percentage of participants might misinterpret the instructions (Aldrovandi et al., 2015b). For example, assigning low days of the month to high percentile points and high days of the month to low percentile points (e.g., believing that a small percentage of people engage in restrained eating a few days per month and a high percentage engage in restrained eating most days in the month), or assigning high days of the month to high percentile points and middle values for middle percentiles, only to assign again high days of the month for low percentile points. We decided to exclude participants when the Kendall's τ coefficient between stimuli (i.e., the 11 percentile points) and their responses (i.e., participants estimates for the 11 percentile points) was < 0.95. This led to the removal of 109 participants, the reasons for excluding participants were as follows; participants answered the questions the wrong way round in ascending order or the same response was given for each percentile question. This left 28 participants who completed the questionnaire correctly. Due to the low number of participants that completed the questionnaire correctly, we decided to investigate participants beliefs about the distributions of restrained eating of females they follow on Instagram and in the UK population.

Participant's beliefs about the distribution of restrained eating within the UK population and females they follow on Instagram did not appear to differ. A 9 (Within: distribution questions) X 2 (Between: distribution Instagram vs UK population) mixed ANOVA found there was no significant interaction between answers to the percentile questions and the type of distribution, $F(8,47) = .68$, $p < .70$). There was a significant main effect of percentage questions, a higher number of days were allocated to the higher percentile questions, e.g., participants estimated that females in the top 10% (90^{th} percentile) of the UK population and on Instagram engaged in the greatest number of days of restrained eating, $F(8,47) = 145.92$, $p < .01$. However, the main effect comparing the two types of distributions was not significant $F(1, 54)= .24$, $p < .59$, suggesting no difference in the perceptions of restrained eating of females in the UK population and females on Instagram.

Figure 28 *Mean percentile estimates of the days of the month females engage in restrained eating in study 2 (N = 28)*



7.11. Study 7 Discussion

Study 7 aimed to test whether female participants' perceptions of where their own restrained eating behaviour ranks among other women predicts how worried they are about their restrained eating. Study 7 replicated study 6 but made some changes in order to address the methodological limitations of study 6. Therefore, unlike study 6, a comprehensive definition of restrained eating was added to the study 7 to ensure participants understood what was meant by restrained eating. Additionally, participants were also asked to state their level of worry with their own restrained eating.

In study 7, we investigated perceptions of social norms in relation to restrained eating in two distributions; other females who participants follow on their Instagram account and other females in the UK population (like study 6). However, study 7 investigated whether participants rank of restrained eating with a) females on Instagram b) females in the UK population predicted their level of *worry* about their own restrained eating. Due to only a small number of participants completing the questionnaire correctly, data analysis focused on the difference between the social distributions for the two reference groups (females in UK population/females participants follow on Instagram). In other words, data analysis focused on participants' beliefs about how often females engage in restrained eating both in the UK population compared with beliefs about how often females they follow on Instagram engage in restrained eating. Perceptions of restrained eating among females in the UK population and females participants follow on Instagram did not differ. One possible explanation is that the estimations of one distribution entered the minds of the participants and influenced their answers. However, to mitigate this, participants were randomly allocated to answer questions about their beliefs of restrained eating in either Instagram or UK population questions first.

7.12. General Discussion

Study 6 investigated the beliefs of the social distribution of restrained eating in two reference groups (UK population and Instagram). We investigated whether participants rank of restrained eating predicted their perception of their own restrained eating, the results were non-significant. Study 7 aimed to improve on the methodology of study 6. Study 7 investigated perceptions of social norms in relation to restrained eating in two distributions; females participants follow on their Instagram account and females in the UK population. However, study 7 investigated whether participants rank of restrained eating with a) females on Instagram b) females in the UK population predicted their level of worry about their own restrained eating. No differences were found between perceptions of restrained eating among females in the UK population and females participants follow on Instagram.

Study 7 extends previous research eliciting beliefs about social distributions such as Melrose et al. (2013) as the present studies explored participant's perceptions of two reference groups (UK population and Instagram) opposed to the UK population in general. A strength of study 7 is that to the authors knowledge it is the first study to explore participant's beliefs about the distribution of restrained eating in different reference groups. However, a limitation of this study is that only a small number of participants appear to have completed the social distribution questions correctly. This result is surprisingly as the same methodology of eliciting distributions has been successfully used in previous studies (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Melrose et al., 2013). One explanation for participants incorrectly completing the questionnaire could be because estimating the number of days people engage in a behaviour is challenging. However, previous research eliciting distributions have successfully asked participants questions about the number of days per month they believe other people experience symptoms of anxiety and depression (Melrose et al., 2013). It is possible that estimating the number of days other people engage in restrained eating was difficult because restrained eating is a broad concept and it may have been interpreted differently by participants (see Polivy et al. (2020) for a recent discussion on the many interpretations of restrained eating). Studies 6-7 used a broad definition of restrained eating, however some researchers refer to restrained eating using the EDE-Q "food avoidance" item, "going without food for a period of 8 or more waking hours in order to influence weight or shape" (Drobnjak et al., 2014). It is possible that using this definition may have made the task easier for participants to estimate restrained eating of other people as it is just focused on one eating behaviour rather than several different components of restrained eating as per the restrained eating scale of the EDE-Q. With this in mind, future research could replicate study 7 but instead ask participants about their perceptions of a more clearly defined disordered

eating behaviour (e.g., purging). There is another explanation for the non-significant results of studies 6 and 7. It is possible that people do not naturally think about their suffering in terms of number of days per month when they suffer from symptoms, especially if those symptoms are broad in relation to restrained eating as discussed above. It is possible that people experiencing symptoms (e.g., disordered eating behaviours, mental health) have a different experience and reasoning about their symptoms- some people who are experiencing symptoms may not recognise they are. With this in mind, it might be interesting to explore perceptions of restrained eating between clinical and non-clinical participants, this could be achieved initially using a qualitative approach.

In order to take part in study 6 and 7 participants were required to have an Instagram account. However, a limitation of this approach is that high engagement with Instagram was not a requirement for participating. Therefore, it is possible that participants were eligible to take part but did not actually utilise or engage with their Instagram account very frequently. Future research could measure participant's levels of engagement with Instagram as a covariate, as it is possible that individuals who use Instagram more frequently may engage in more frequent social comparisons and likewise those who engage in social comparisons may be more likely to spend more time on Instagram. It would be interesting to ascertain perceptions of disordered eating behaviours among people who follow fitness or healthy eating focused accounts on Instagram as research suggests following these types of accounts are associated with disordered eating (e.g., Lewallen & Behm-Morawitz, 2016; Turner & Lefevre, 2017). This is important as it might provide a biased social context in which people judge their own eating behaviours against. From a methodological perspective, studies 6 and 7 have highlighted an important distinction in how restrained eating is interpreted. Indeed, there are varying definitions of restrained eating in the literature. A review noted the distinction in the literature between how dietary restraint can be perceived both negatively and positively (Schaumberg et al., 2016a). From a negative perspective, restrained eating behaviours may increase someone's eating pathology risk, on the other hand dietary restraint may lead to positive results (e.g., weight loss and longer-term weight management) via fasting or eating certain foods in reduced amounts without eliminating foods completely (Schaumberg et al., 2016a). For example, the 5:2 diet, requires people to limit their calorie intake to 500 calories on two days in the week, it is endorsed by some medical professionals and in this context could be viewed as restrictive but 'healthy' (Hajek et al., 2021). Furthermore, alternative attention checks could have been used for study 7. For example, an attention check could have been used throughout the study to ensure participants were attending to the questionnaire (e.g., 'So we know you are paying attention, please select option 4.') (Webber et

al., 2021). However, the attention check selected for study 7 required participants to have read and understood the restrained eating definition in order to answer questions about restrained eating to the best of their ability.

7.13. Conclusion

In conclusion, two studies utilised a novel methodology to elicit perceptions of restrained eating in two different distributions. study 6 found that rank of restrained eating did not predict judgements towards levels of own restrained eating. Study 7 found no difference in perceptions about the amount other females engage in restrained eating per month in either Instagram and UK population. Results of this study were inconclusive. The study found no differences in perception of restrained eating per month between the reference groups. Future research could explore alternative methods to understand social norms of eating behaviours within reference groups.

7.14. Chapter 7 Summary

This chapter reported on the findings of studies 6 and 7 which began with aims and objectives for chapter seven. Then, the context of the two studies were discussed in relation to the findings of chapter five (studies 1, 2 and 3) and chapter six (studies 4 and 5). The abstract and an introduction for studies 6 and 7 was then provided, then findings were presented. Next, a general discussion of both studies which compares the findings to existing literature, the implications of the findings were considered and limitations of the studies. Findings from this chapter were inconclusive.

Chapter 8: General Discussion

8.1. Chapter 8 Overview

In this final chapter the main findings are summarised from each study. Next, the theoretical implications and practical relevance of the findings are discussed. Then, the strengths and limitations for the studies are presented as well as suggestions for future research. The chapter will finish with a conclusion.

8.2. Overview of study findings

This thesis had one main aim; to understand perceptions of social norms and reference groups in relation to eating behaviours and weight judgements. To achieve this, the thesis was broken down into several studies with individual objectives. Studies 1-7 applied a *rank-based* model to judgements about body weight and eating behaviours (except for the systematic review).

Chapter five 'Rank and reference groups for body weight judgements'

Chapter five objectives

- To test whether rank of body weight with other people influences several subjective weight related judgments (e.g., weight status) and examine rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population) **(study 1)**
- To explore the composition of reference groups when people rank their body weight with that of others **(study 2)**
- To understand further who participants compare themselves with when ranking their body weight with others by eliciting a distribution of two key reference groups (UK population and friends/family) **(study 3)**

Chapter five (studies 1, 2 and 3) applied a rank-based model to body weight judgments and explored reference group composition when making body weight judgments. The aim of study 1 tested whether people's rank of body weight with others influenced several subjective weight related judgments (e.g., weight status) and examined rank of body weight in relation to different reference groups (e.g., people who live in your neighbourhood, people working at your organisation, friends, UK population). It was hypothesised that where individuals (often-incorrect) beliefs about their ranked position of body weight will predict their weight status, perceived risk of disease associated with overweight, motivation to lose weight and motivation to engage in physical activity. Firstly, study 1 demonstrated that people used rank of body weight with other people to make subjective judgements (e.g., weight status, perceived risk of diseases with overweight). Specifically, participants rank of body weight with friends was the most important reference group when making weight status judgements (e.g., healthy weight).

Whereas rank of weight with the UK population was the most important reference group for other outcome variables (e.g., perceived risk of diseases with overweight and motivation to lose weight).

Study 2 aimed to explore the composition of a reference group when people rank their body weight with others. Study 2 offered an opportunity to clarify the results of study 1 by using a different method of eliciting participant's perceived rank of weight. Here, participants were asked to rank their body weight with '*other*' people, opposed to asking participants to rank their weight with pre-defined populations (study 1). Again, it was hypothesised that participants beliefs about their ranked position of body weight with other people would predict judgements about their weight status and perceived risk of disease associated with overweight. Next, participants were then asked to provide further information about the '*other*' people they had compared their weight with when answering the rank question. Study 2 found again that where people ranked their weight influenced judgements towards weight status, supporting the results of study 1. However, study 2 provided further information about who people include in their reference group when making a weight judgement. Exploratory analysis revealed that in relation to gender of reference group members participants predominantly included people of the same gender (this effect was most pronounced for females). Furthermore, participants also predominantly included friends and family in their weight reference group.

The combined results of study 1 and study 2 suggested that people utilised either their beliefs about the a) UK population or b) friends and family when ranking their weight with others and used where they rank in one of these distributions to make weight related judgements. The aim of study 3 was to try to understand whether participants use their underlying beliefs about the distribution of weights in two key reference groups either: UK population or their friends and family to make a weight-based judgement (e.g., weight status, perceived risk of diseases with overweight). For each participant, a distribution of weights was elicited among the UK population and among their friends and family. Using both distributions, participants own objective weight (kgs) was used to calculate where they ranked within the elicited distributions they provided for UK population and friends/family. Based on the results of study 3, it is still unclear which distribution people used over the other when ranking their weight. Although, the findings suggest that participants may have sampled the weights of friends/family slightly more when making a body weight judgement. It is possible that people use a combination of both their beliefs about the weights among a) friends and family and b) UK population when ranking their weight with others and then use this perceived rank to make weight related judgments (e.g., weight status). Collectively, the studies in chapter five suggest

that people use perceived rank with others to make body weight judgements. The studies presented in chapter five extend previous literature on rank by applying relative rank to body weight judgements (Maltby et al., 2016). More broadly the studies also expand previous research exploring rank effects by examining relative rank with different populations as opposed to a particular group such as students (Aldrovandi et al., 2015b). A novel contribution was exploring the composition of the reference group of which can be applied to any domain.

Chapter six 'Rank based sensitivity in subjective perception of weight'

Chapter six objectives:

- To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight* (scale 1 'very underweight' to 5 'very overweight') of male 3D figures **(study 4)**
- To test two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight (mean vs rank models), participants were asked to judge the *weight status* (e.g., overweight) of male 3D figures **(study 5)**

The studies in chapter six aimed to build on the results in chapter five which demonstrated that people use rank of weight with others to influence weight related judgements. Studies in this chapter experimentally tested two competing cognitive mechanisms underlying how comparison context influences people's subjective judgments of weight. The first account posits that people's judgments reflect sensitivity to the mean of a comparison context; the second is that people are sensitive to the rank position of a judged stimuli among other stimuli in a comparison context. Study 4 aimed to test whether manipulating the rank position of a 3D figure within a sample influenced participants perceived weight judgment of a figure representing the same waist size (and weight status) when presented in a different context. Participants were randomly allocated to one of four skewed distributions of the 3D figures (unimodal, bimodal, positive, or negative). Next, participants were asked to judge the perceived weight of a male 3D figure (on a 1 'very underweight' to 5 'very overweight') among other 3D figures representing different waist sizes. As hypothesised, the figure with the same waist size (and therefore weight status) was rated differently depending on its ranked position. Study 4 demonstrates that perceived weight judgements can be manipulated by changing the rank a 3D figure. The results showed that weight judgements appear to be context dependant, regardless of the 'objective' weight of the figures.

Building on the results of study 4, a further study was conducted. In study 5, participants were required to judge the individual figures using descriptive labels of weight

status (underweight, healthy weight, overweight, obese and severely obese). Once again, study 5 demonstrated that weight judgements were influenced by where a figure ranked within a sample rather than objective weight. However, this time the effect was illustrated using descriptive weight categories (e.g., healthy weight, obese). Study 5 demonstrated how participants underestimated the weights of figures with the same waist size and weight status in one sample compared to another. Participants underestimated the weight status of healthy and obese figures due to the rank position of the figures in different contexts. This supports previous research studies that have found that underestimation of *others* with overweight and obesity to be common. For example, parents have been shown to underestimate the weight status of children with overweight or obesity and medical professionals have been shown to underestimate the weight status of patients with overweight or obesity (e.g., Jones et al., 2011; Lundahl et al., 2014).

Taken together, findings from chapters five and six provide evidence against the idea that people rely on an average or 'norm' to make a body weight judgement. Studies 4 and 5 provide an explanation for the underlying cognitive mechanisms for *how* people make a judgement. Furthermore, studies 4-5 provide direct experimental evidence that people rely on rank, not the mean of a sample (directly demonstrated via bimodal and unimodal results) and that this underlying mechanism can be applied to any human judgement. Therefore, studies 4-5 have broader implications beyond weight judgements.

Chapter seven: 'Perceptions of restrained eating norms across reference groups in a non-clinical female sample'

Chapter seven objective:

- To test a rank-based approach as an underlying mechanism to explain people's *judgements* towards their restrained eating **(study 6)**
- To test a rank-based approach as an underlying mechanism to explain people's perceived *worry* towards their restrained eating **(study 7)**

The studies presented in chapter seven aimed to understand more about beliefs of social norms relating to disordered eating behaviours. More specifically, studies 6-7 presented in this chapter utilised a rank-based approach as an underlying mechanism to explain people's judgements towards their restrained eating and learn about perceptions of restrained eating in two different reference groups. Study 6 was a pilot study which tested whether perceptions of restrained eating of other females influences participants judgements towards their own level of restrained eating. Female participants provided information on (a) their own levels of restrained eating behaviour (in exact days per month) (b) their perceptions of restrained eating in the UK population and females they follow on Instagram and (c) their judgements to

the extent to which they engage in restrained eating. The results of study 6 were inconclusive, we believed this was due to limitations with the methodology in study 6 (such as not providing participants with a comprehensive definition of restrained eating). Therefore, study 7 replicated the same study as study 6, however females participants answered questions about (a) their own levels of restrained eating (b) their perceptions of restrained eating in the UK population and Instagram (c) their perceived level of worry towards their own restrained eating. Despite the changes to the methodology (detailed in chapter seven), the results from studies six and seven remained inconclusive. It is still unclear how people perceive restrained eating in different reference groups. It is also unclear whether people utilise a rank-based approach to inform their beliefs about their own restrained eating and inform related judgements i.e., level of worry towards their own restrained eating.

8.3. Theoretical Implications

The studies presented in this thesis have various theoretical implications which will be discussed below:

a) Understanding the cognitive mechanisms behind how people make weight judgements.

The findings from studies based in chapters five and six offer insights into explaining the cognitive mechanisms by which people make body weight judgments. Here, findings from chapter five suggested that people use rank to inform their body weight judgements in three separate studies. Further to this, findings from chapter six provide *direct experimental* evidence that people do not rely on the mean, but instead use rank to make a weight judgement. Together these studies (1-5) support the idea that people do not rely on the average or 'norm' to make a body weight judgement but use their perceived rank relative to others. It is important to consider the findings presented in studies 1-5 in relation to previous theories that have been used to explain how people make weight judgements and judgements more generally. As discussed in the introductory chapter (chapter 1), researchers have proposed a number of theories in a bid to explain how people make a weight judgement. Researchers have proposed that people may use a single reference point (e.g., mean of a sample) in order to make a weight related judgement (Helson, 1964). For example, the visual normalisation theory proposes that people use an internal average to make an (often-incorrect) weight judgement (Robinson, 2017; Robinson & Kersbergen, 2017). Alternatively, research across hundreds of domains suggests that rank may be important for judgements and is central to theories such as Decision by Sampling (e.g., Boyce et al., 2010; Melrose et al., 2013; Wood et al., 2011). In support of hundreds of previous studies, the results of studies 1-3 suggest rank is important when making a subjective judgement (e.g., Boyce et al., 2010;

Melrose et al., 2013; Wood et al., 2011). In particular, studies 1-3 suggest that rank may be important for weight related judgments such as weight status. Studies 4-5 provide direct experimental evidence that people used the rank position of a stimuli to make a weight judgement over and above the mean of that sample. This result is in contrast with reference level theories which propose that people use one single reference point e.g., the mean to make a judgement (Clark & Oswald, 1996). Studies 4-5 only demonstrate that people used rank over the mean of the sample, they do not enable us to test any other theory. However, the present thesis was not designed to contrast the effects of rank against all other theories. Given that reference level theories still dominates in studies examining weight judgements, the results from 1-5 are important.

Furthermore, the findings of chapter 5 in particular have implications in explaining why the weight status of people with overweight and obesity is commonly underestimated. Specific to underestimation of overweight and obesity, some previous studies have suggested that people rely on an internal average or reference point to make a weight judgement and that because the 'normal' body size has increased in society, people's perceptions of an average body size has increased. Therefore, if people use their interpretation of an average body size (which is often incorrect) as a reference point when judging the weight of themselves or other people, researchers have suggested this can lead to underestimation of overweight and obesity (e.g., Robinson, 2017; Robinson & Kersbergen, 2017). Here, we present an alternative explanation, in that people use rank relative to others to make a body weight judgement, not the average. If people used an internal average of what they perceive to represent a normal weight to make a body weight judgement, then we would expect the figures to be judged the same in studies 4-5 regardless of the distribution.

b) Understanding reference group composition

This thesis has considered several reference groups as important sources of the social norm which may be used to inform people's judgements. It has also considered how different reference groups might be more influential on people's beliefs and their perceptions of the social norm. Chapter 5 (studies 1, 2 and 3) explored reference group composition using a novel methodology. By directly examining reference group composition in study 2, the study attempted to address limitations of previous social judgment studies that often only ask participants about a pre-specified reference group and make assumptions that people use this one reference group (e.g., Aldrovandi et al., 2015a; Moore et al., 2016). Additionally, the findings of studies 1-5 not only extend our knowledge around body weight judgements but more generally increase our understanding about reference group composition. Therefore, the findings may have broader implications for social judgment studies in other domains. For

example, the methods utilised in this thesis may be used by other researchers wishing to explore reference group composition in other research areas.

c) Implications of rank-based models of judgment in the context of eating behaviours

Findings reported in this thesis have demonstrated that rank is important for body weight judgements (chapter 6, studies 1-5). This finding supports hundreds of prior research studies on other domains demonstrating that people use their perceived rank relative to others to make a judgement (e.g., Aldrovandi et al., 2015a; Aldrovandi et al., 2015b; Maltby et al., 2012). Given this, it is reasonable to assume that people use rank to inform judgements relating to eating behaviours. Indeed, a previous study explored rank in the context of chocolate bar consumption (Aldrovandi et al., 2015a). Aldrovandi et al. (2015a) elicited students' beliefs about the chocolate bar consumption of other students. The study found that students level of concern towards their own chocolate bar consumption was predicted by where they ranked their own chocolate bar consumptive relative to that of other students. They found that participants who consumed a large amount of chocolate bars showed no concern towards their own level of chocolate consumption if they believed many other students consumed the same or more (Aldrovandi et al., 2015a). This is important as participants evaluated their own behaviour in reference to their beliefs about what other people do, and these beliefs may often be inaccurate. Given this, it is likely that people use rank with others when making judgements about other aspects of their eating behaviours (i.e., whether they believe their diet is healthy or unhealthy). As demonstrated in study 2, people commonly used members of their family and friends when ranking themselves with 'other' people. This was demonstrated when participants ranked themselves on different domains such as weight and personality. This is important as research studies suggest that diets of connected individuals are more likely to be similar (e.g., de la Haye et al., 2013; Pachucki et al., 2011). Consequently, if people compare their eating behaviours with others in biased samples (e.g., their friends and family frequently consume a large amount of junk food) they may rank themselves in the lower end of the sample (i.e., 'I am healthy') and wrongly believe they are 'healthy' when objectively they are not. Research suggests that where people rank themselves and use this information to inform a subjective judgement may differ depending on the shape of the distribution they are making the comparison with (Aldrovandi et al., 2015b; Wood et al., 2011). Indeed, studies 4-5 provide experimental evidence that the shape of a given distribution is important for judgments and that people are sensitive to the rank of position of judged stimuli amongst other stimuli. Rank judgements about eating and weight may have implications for future behaviour (e.g., if someone believes they have an unhealthy diet relative to others, they may be more likely to eat more fruit and vegetables). On the other hand, people could be sensitive

to rank effects if viewing a small segment of people on social media platforms who appear to eat very "healthy" but follow restricted diets. As a result, they might wrongly assume their own eating behaviours are unhealthy in comparison, which may negatively affect their own behaviours (e.g., people may develop an obsession with healthy eating i.e. orthorexia) (Turner & Lefevre, 2017). A similar experimental design like studies 4-5 could be applied to other areas of eating behaviours. Further research could examine whether people use rank to inform their food choices when dining in a restaurant. This year the UK government has instructed all larger restaurants in the UK to include calorie labelling on their menus (Yeo, 2022). It would be interesting to examine whether people judge an item to be healthy or not depending on its rank position in a specific context. Indeed, a similar methodology could be employed as studies 4 and 5, in which participants were asked to judge the weight of varying sized figures. Instead, people could be presented with different meal options (similar to a menu) and shown the calorie information for each dish and asked to judge the 'healthiness' of each meal. The rank of the target stimuli could be manipulated (like studies 4-5), for example in a positive distribution, a meal with 650 calorie might seem unhealthy but the same meal ranked in a negative distribution with the majority of meals a higher calorie amount might seem healthier in contrast. This is important to also consider in terms of people with eating disorders and/or disordered eating. These individuals may be more sensitive to calorie information, and this may have a greater impact on their food choices. Additionally, the same study concept could also be tested with portion sizes, whereby depending on the rank of a portion size and the context it is situated in, it may appear more healthy or less healthy.

8.4. Practical Implications

a) Implications of rank for interventions

Studies 1-5 demonstrated that when making a weight judgment people are sensitive to rank. Sensitivity to rank position amongst others may maladaptively lead people to assume that they weigh less and therefore believe they are less at risk of diseases associated with overweight than they objectively are. Given this, the results may inform future social norms interventions. Typically, social norms interventions offer information on how an individual's undesirable behaviour compares to others (e.g., the average). However, the effectiveness of such interventions are limited (Aldrovandi et al., 2015a). A previous study tested a rank-based intervention for healthy eating. Aldrovandi et al. (2015a) found that informing people about where they believed their consumption of chocolate bars ranks within the university student population and what their actual rank in this population was increased people's willingness to pay for a healthy food item compared to informing participants of how their behaviours compare to the average student. In the context of studies 1-5, by demonstrating the

importance of rank in body weight judgements, it may prove beneficial to provide individuals with information about where they rank opposed to how they compare with the 'average' person. This approach is believed to be more effective than typical social norms interventions (Aldrovandi et al., 2015a). For example, informing people where they rank amongst a broader reference group (e.g., 'you're in the top 70% of the UK population at risk of diseases associated with overweight') (Moore et al., 2016). Furthermore, our findings may also have clinical implications for professionals working in weight management. For example, individuals with obesity might benefit from an intervention that informs them of where they objectively rank with others compared to their subjective rank.

b) Implications for social media

Evidence suggests that social media can be a source of upward comparisons on appearance and body weight. For example, researchers have reported that time spent on social media can be associated with disordered eating behaviours and can negatively affect users judgements towards their body weight (e.g., Fardouly et al., 2017; Lewallen & Behm-Morawitz, 2016; Moorman et al., 2020; Turner & Lefevre, 2017; Wilksch et al., 2020). In terms of social media, one mechanism that may influence how social media users make judgements about their weight, appearance and eating behaviours is via *rank*. Studies 4 and 5 (chapter six) suggest that the shape of a distribution can result in incorrect beliefs of the social norm and lead to incorrect judgements. This is important given that images on social media platforms typically portray very slim bodies and therefore represent a positively skewed distribution (Slater et al., 2019). Consequently, it may be beneficial for social media users to follow a diverse range of people on social media (e.g., in relation to eating behaviours and weight) to ensure a more varied reference group for comparisons. It would be interesting to examine whether social media users rank their body weight with others on platforms such as Instagram and whether this influences subjective judgements. For example, a similar methodology could be adopted as used in study 1, chapter five.

8.5. Strengths and Limitations

This section will consider the strengths of the studies presented in this thesis. Novel methods were employed to explore reference groups composition (chapter five), including asking participants to rank themselves with multiple reference groups and exploring reference group composition, these methods can be used in different domains. Furthermore, a strength of chapter six (studies 4-5) was that the 3D images were based on real life waist measurements, researchers have suggested that waist circumference is a better indicator of health than BMI (Ross et al., 2020). Where possible, validated scales were used within the studies such as the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994). On the other hand, several limitations were discussed in each empirical chapter. A summary of limitations if offered in the section below.

Chapter Five (studies 1, 2 and 3)

First, the limitations of chapter five are discussed. Study 1 tested whether people use rank of weight with various reference groups to inform subjective weight judgements. I selected the most salient reference groups based on previous literature (e.g., friends, people in the same neighbourhood, people working in the same organisation, UK population). However, for practical reasons it was only feasible to ask participants about a small selection of reference groups. Given that study 1 only asked participants to rank their body weight with a limited number of reference groups, this limitation was taken into consideration in the design of study 2. Study 2 aimed to understand exactly who people include in their reference group when ranking their weight. Therefore, in study 2, participants were asked to rank their weight with '*other*' people opposed to pre-specified reference groups and then provided more information about the type of person in their reference group. An interesting finding from study 2 was that people incorporated their family into their weight reference group. Therefore, given that participants were not asked to rank their weight with their family in study 1, it would be interesting to test participants rank of weight with further groups such as family in future studies.

In study 2 and 3 participants were asked about the composition of the reference group. Participants were asked to estimate the weight and height of people in different reference groups. This task may have been challenging for some participants. However, estimating the objective weight of reference group members was considered a better alternative to BMI, as it is unlikely people would be able to accurately predict people's BMI (e.g., estimate that someone has a BMI of 22). Furthermore, when participants were asked to rank their weight with other people, it is difficult to know if people would have used perceived BMI, fat distribution or even absolute weight (kg) to make this judgement. A study by Robinson

and Oldham (2016) compared people's self-reported BMI with objective BMI scores (measured by a trained researcher). They found that a large proportion of people with overweight misperceive their weight status and recommend that objective measures of BMI should be used where possible. However, collecting objective BMI was not feasible when collecting data from participants on online platforms such as Prolific. Importantly, it should be noted that the studies included in this thesis investigated people's perceptions of their weight and the weight of others, and therefore it was not crucial to the findings of the studies whether their answers were correct or not.

A further limitation of chapter five (studies 1, 2 and 3) (rank effects and reference group composition) was the stimuli used. In all three studies, participants were asked to rank their weight with other people, they were asked to do so using a diagram of figures which resembled the outline of male figures in a horizontal line. As a result, the figures used in studies 1, 2 and 3 visually appeared as the same size and height and consequently appeared to be the same weight. This may have made it difficult for some participants to accurately rank their weight with others. However, this limitation was addressed in chapter six (studies 4 and 5) used 3D models that were based on real life BMI scores and therefore participants were exposed to a variety of body sizes.

Chapter Six (studies 4 and 5)

In both study 4 and 5, participants were asked to judge the weight (study 4) and weight status (study 5) of a horizontal line of 11 3D figures. A limitation concerns the stimuli used. Although the 3D models represented people with different weights, they lacked ecological validity because the figures were blue and did not have detailed features of real people. However, a strength of the study is that the program used to create the stimuli had a feature to manipulate the height of the figures. This ensured that height could be controlled within the study as all figures were based on the same height (average male in the UK). Although, participants were not informed of the height of the figures. Furthermore, studies four and five only used male 3D figures. Therefore, it would be valuable to repeat this research using female figures. Studies 4 and 5 showed participants the images simultaneously, future research could replicate the studies demonstrating the images one after each other as this might resemble real life encounters.

Chapter Seven (studies 6 and 7)

Study 7 served as a pilot study. The main limitation of the pilot study was that it did not provide participants with a comprehensive definition of restrained eating. It is possible that some people may have understood restrained eating to be a positive health behaviour. For example the 5:2 diet, requires people to limit their calorie intake to 500 calories on two days in

the week, it is endorsed by some medical professionals and in this context could be viewed as restrictive but 'healthy' (Hajek et al., 2021). However, a more detailed definition of restrained eating was provided in study 7. Participants were also required to answer an attention check question (i.e., participants were instructed to select the correct answers corresponding to the definition of restrained eating they had viewed on the previous page before they could take part in the main survey). The attention check was utilised as a means of ensuring participants understood a definition of restrained eating. Alternative attention checks could have been used for study 7. For example, an attention check could have been used throughout the study to ensure participants were attending to the questionnaire, participants could have been asked about something unrelated to the project (e.g., 'So we know you are paying attention, please select option 4.') (Webber et al., 2021). The attention check selected for study 7 required participants to have read and understood the restrained eating definition and therefore complete the survey questions as accurately as possible. Another limitation is that it is possible that the task in studies 6 and 7 was complicated for participants. To mitigate this, after the pilot study, clearer instructions were added to the distribution elicitation task. Furthermore, participants were eliminated in the second study if that had admitted they completed the questions incorrectly. This led to a small sample of participants included in the study. Additionally, in order to take part in study 6 and 7 participants were required to have an Instagram account. However, a limitation of this approach is that high engagement with Instagram was not a requirement for participating. Therefore, it is possible that participants were eligible to take part but did not actually utilise or engage with their Instagram account very frequently. Future research could measure participant's levels of engagement with Instagram to investigate this variable as a covariate. This is because it is possible that using Instagram frequently may cause participants to engage in social comparison more often and vice versa.

8.6. General Limitations

In additional to the limitations outlined in each study, there are some general limitations that apply to all studies. Firstly, height and weight was collected for participants in each study (studies 1-7). It was not feasibly possible to obtain objective BMI measurements of participants or BMI measurements of reference group members due to the large number of participants required and the fact that they were recruited online (study 2 and 3, chapter five). It should be noted that this does not affect the results greatly as the studies 1-5 investigated people's perceptions of weights and not the discrepancy between participant's perceptions of weight status and their objective weight. Secondly, studies (1, 2, 3, chapter five) and studies 6 and 7 (chapter seven) were correlational and therefore causality is not possible. However, this

limitation was addressed by studies 4 and 5, which used an experimental design to directly test rank effects. These studies demonstrated that rank can be replicated in an experimental setting and that people appear to use rank over mean when making subjective judgements. Thirdly, in all studies, most participants predominantly identified as White-British. Research reports that BMI and weight may be viewed differently across different ethnicities (e.g., Brug et al., 2006; Chang & Christakis, 2003). Similarly, across all studies (1-7) a high proportion of participants were females. Therefore, future research investigating rank and weight judgments should conduct studies within a more diverse group of participants.

8.7. Future Research Directions

Several suggestions for research were made in relation to the empirical chapters, a summary of suggestions will be provided here. As previously discussed, this thesis has suggested that people rely on rank to make a judgement about their weight and the weight of other people. Therefore, future research could test an intervention by which people with overweight and obesity are informed where they rank in the UK population instead of how they compare to the average. Post intervention this research study could conduct a follow up questionnaire with participants to measure whether the rank intervention affected participants intentions or behaviour e.g., participants motivation to lose weight. This thesis has conducted experimental studies demonstrating that depending on where a figure ranks in a context, the weight of the figure will be perceived differently. Given this, findings from studies 4-5 may also have clinical implications for professionals working in weight management. Individuals with obesity might benefit from an intervention that informs them of where they objectively rank with others compared to their own subjective rank. Previous research has suggested that key people in society such as medical professionals underestimate the weights of patients with overweight and obesity (e.g., Ahern et al., 2012; Robinson et al., 2014). It would be interesting to replicate study 5 with medical professionals and compare these findings to a lay person group, as it is crucial that those working in healthcare recognise an individual with overweight or obesity to help them make lifestyle changes. Additionally, it would be an interesting next step to replicate the 3D study using female 3D figures. As previously discussed, participants may have found study 7 difficult because restrained eating is a broad concept and it may have been interpreted differently by participants (see Polivy et al. (2020) for a recent discussion on the many interpretations of restrained eating). Further research could replicate study 7 but instead ask participants about their perceptions of a more clearly defined disordered eating behaviour (e.g., purging).

Further research ideas have arisen from the collective review of all the studies in this thesis. Firstly, studies 1-5 (particularly studies 4-5) have focused on the implications of

incorrect weight judgements in relation to underestimation of overweight and obesity. However, the findings of studies 4-5 have broad applications that should be discussed. Findings suggest that judgments of weight in context appear to be sensitive to the rank position of one's weight relative to the weights of others. These results lend further support to rank-based models of human judgment and offer insight into the exact mechanisms by which people judge the weight of themselves and others. Given this, it would be interesting to repeat the studies 4-5, however using 3D model figures with lower BMI scores and waist circumferences. The lowest BMI scores utilised in studies 4-5 was 18.2, this represented an underweight male BMI, however a healthy BMI score is 18.5. It would therefore be interesting to replicate the studies using a larger proportion of figures that are underweight. This is important when considering different contexts where people are frequently exposed to images depicting low body weight such social media platforms e.g., Instagram (e.g., Lewallen & Behm-Morawitz, 2016; Slater et al., 2019). It is possible that exposure to figures in a positively skewed distribution (i.e., mostly underweight figures) may affect how people judge a figure representing a healthy weight (i.e., in this context some people may incorrectly perceive a healthy weight figure as overweight). It would be especially interesting to conduct this study among people who spend a lot of time on Instagram and/or have high scores in body dissatisfaction (i.e., young females). This study might give insight into the cognitive mechanisms behind people with healthy or underweight who overestimate their weight and offer potential insights into interventions. Furthermore, it would be interesting to look at the discrepancy between where people rank their weight in the UK population versus where their actual weight might be ranked in relation to the UK population. This would be especially interesting to investigate using participants with overweight or obesity, i.e., do they place themselves in top 60% given the high number of people with overweight and obesity or do they still believe they rank (incorrectly) somewhere in the middle of the distribution. Studies 1-5 used participant's self-reported weight and height submitted online. The studies focused on people's perceptions of weight and therefore the accuracy of participants weight and height was not the focus of the studies. However, it would be interesting to replicate studies 1-5 but instead objectively measure participant's height and weight in order to obtain an accurate BMI score. This would offer an additional element to the results. For example, in studies 4-5, it would be interesting to investigate whether underestimation of figures with overweight and obesity can still be shown regardless of the participants *own* objective weight i.e., underweight, overweight.

8.8. Conclusion

This thesis examined aimed to understand perceptions of social norms and reference groups in relation to eating behaviours and weight judgements. It makes original contributions to the existing literature;

- Chapter two (systematic review) provides an evidence-based summary of the factors affecting eating behaviours in the office-based workplace, whereas previously a review only covered factors affecting healthy eating behaviours of nurses in a hospital setting.
- Chapter five (studies 1, 2 and 3) provides convincing support for the fact that people rely on rank to make a weight related judgement.
- Chapter six (studies 4 and 5) provided further support for rank effects when making a body weight judgement. This supports many previous studies that have experimentally demonstrated that people rely on rank in a sample rather than the mean to inform a judgement.
- Chapter six (studies 4 and 5) found that people underestimated the weight status of a healthy figure (believing it was underweight), overweight (believing it was healthy) and obese figure (believing it was overweight) in certain contexts. These findings offer an alternative explanation to how and why people might underestimate the weight of others (i.e., that people rely on an internal average of what represents a normal figure).
- Taken together chapter five and chapter six make an original contribution to knowledge by explaining the underlying cognitive mechanisms of how people make weight judgements.
- Chapter five (studies 1, 2 and 3) explored the composition of reference groups using a novel methodology, something often overlooked by social judgement studies.
- Chapter seven (studies 6 and 7) applied rank to disordered eating behaviours and investigated perceived social norms of restrained eating in different reference groups, something which hasn't been investigated previously.

References

Uncategorized References

Achtypi, E., Ashby, N. J. S., Brown, G. D. A., Walasek, L., & Yechiam, E. (2021). The endowment effect and beliefs about the market. *Decision, 8*(1), 16-35. https://doi.org/10.1037/dec0000143

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience, 7*, 425. https://doi.org/10.3389/fnhum.2013.00425

Ahern, T. s., Doherty, K., Kapeluto, D., Davis, M., Mulholland, U., Rossiter, E., Gilroy, I., Billfalk-Kelly, A., FitzPatrick, P., Daly, L., Kelleher, C., & Oi¯Shea, D. (2012). Body mass index estimation and measurement by healthcare professionals. *Open Journal of Preventive Medicine, Vol.02No.03*, 7, Article 21543. https://doi.org/10.4236/ojpm.2012.23038

Aldrovandi, S., Brown, G. D. A., & Wood, A. M. (2015a). Social norms and rank-based nudging: Changing willingness to pay for healthy food. *Journal of Experimental Psychology: Applied, 21*(3), 242-254. https://doi.org/10.1037/xap0000048

Aldrovandi, S., Wood, A. M., Maltby, J., & Brown, G. D. A. (2015b). Students' concern about indebtedness: a rank based social norms account. *Studies in Higher Education, 40*(7), 1307-1327. https://doi.org/10.1080/03075079.2014.881349

Ali, K., Fassnacht, D. B., Farrer, L., Rieger, E., Feldhege, J., Moessner, M., Griffiths, K. M., & Bauer, S. (2020). What prevents young adults from seeking help? Barriers toward help-seeking for eating disorder symptomatology. [https://doi.org/10.1002/eat.23266]. *International Journal of Eating Disorders, 53*(6), 894-906. https://doi.org/https://doi.org/10.1002/eat.23266

Allan, J., Querstret, D., Banas, K., & de Bruin, M. (2017). Environmental interventions for altering eating behaviours of employees in the workplace: a systematic review. *Obesity reviews : an official journal of the International Association for the Study of Obesity, 18*(2), 214-226. https://doi.org/10.1111/obr.12470

Astbury, N. M., Piernas, C., Hartmann-Boyce, J., Lapworth, S., Aveyard, P., & Jebb, S. A. (2019). A systematic review and meta-analysis of the effectiveness of meal replacements for weight loss. *Obesity Reviews, 20*(4), 569-587. https://doi.org/10.1111/obr.12816

Baskin, E., Gorlin, M., Chance, Z., Novemsky, N., Dhar, R., Huskey, K., & Hatzis, M. (2016). Proximity of snacks to beverages increases food consumption in the workplace: A field study. *Appetite, 103*, 244-248. https://doi.org/https://doi.org/10.1016/j.appet.2016.04.025

BDA. (2017). *Food and Mood*. Retrieved 1st July 2018 from https://www.bda.uk.com/foodfacts/foodmood.pdf

Becker, A. E. (2004). Television, disordered eating, and young women in Fiji: negotiating body image and identity during rapid social change. *Cult Med Psychiatry, 28*(4), 533-559. https://doi.org/10.1007/s11013-004-1067-5

Belot, M., & James, J. (2011). Healthy school meals and educational outcomes. *Journal of Health Economics, 30*(3), 489-504. https://doi.org/https://doi.org/10.1016/j.jhealeco.2011.02.003

Bhanji, S., Khuwaja, A. K., Siddiqui, F., Azam, I., & Kazmi, K. (2011). Underestimation of weight and its associated factors among overweight and obese adults in Pakistan: a cross sectional study. *BMC Public Health, 11*, 363. https://doi.org/10.1186/1471-2458-11-363

Bicchieri, C., & Dimant, E. (2019). Nudging with care: the risks and benefits of social information. *Public Choice*. https://doi.org/10.1007/s11127-019-00684-6

Binkin, N., Spinelli, A., Baglio, G., & Lamberti, A. (2013). What is common becomes normal: the effect of obesity prevalence on maternal perception. *Nutr Metab Cardiovasc Dis, 23*(5), 410-416. https://doi.org/10.1016/j.numecd.2011.09.006

Blanchflower, D., & Oswald, A. (2004). Well-being over time in Britain and the USA. *Journal of Public Economics, 88*(7-8), 1359-1386. https://EconPapers.repec.org/RePEc:eee:pubeco:v:88:y:2004:i:7-8:p:1359-1386

Bolton, P. (2022). *Higher education student numbers* https://researchbriefings.files.parliament.uk/documents/CBP-7857/CBP-7857.pdf

Boyce, C. J., Brown, G. D. A., & Moore, S. C. (2010). Money and Happiness:Rank of Income, Not Income, Affects Life Satisfaction. *Psychological Science, 21*(4), 471-475. https://doi.org/10.1177/0956797610362671

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Brown, G. D., Gardner, J., Oswald, A. J., & Qian, J. (2008). Does wage rank affect employees' well‐being? *Industrial Relations: A Journal of Economy and Society, 47*(3), 355-389.

Brown, G. D. A., Wood, A. M., Ogden, R. S., & Maltby, J. (2015). Do Student Evaluations of University Reflect Inaccurate Beliefs or Actual Experience? A Relative Rank Model. [https://doi.org/10.1002/bdm.1827]. *Journal of Behavioral Decision Making, 28*(1), 14-26. https://doi.org/https://doi.org/10.1002/bdm.1827

Brown, H. S., Evans, A. E., Mirchandani, G. G., Kelder, S. H., & Hoelscher, D. M. (2010). Observable Weight Distributions and Children's Individual Weight Assessment. *Obesity, 18*(1), 202-205. https://doi.org/https://doi.org/10.1038/oby.2009.168

Brug, J., Wammes, B., Kremers, S., Giskes, K., & Oenema, A. (2006). Underestimation and overestimation of personal weight status: associations with socio-demographic characteristics and weight maintenance intentions. *J Hum Nutr Diet, 19*(4), 253-262. https://doi.org/10.1111/j.1365-277X.2006.00707.x

Carey, M., Kupeli, N., Knight, R., Troop, N. A., Jenkinson, P. M., & Preston, C. (2019). Eating Disorder Examination Questionnaire (EDE-Q): Norms and psychometric properties in U.K. females and males. *Psychol Assess, 31*(7), 839-850. https://doi.org/10.1037/pas0000703

Chancellor, J., Layous, K., Margolis, S., & Lyubomirsky, S. (2017). Clustering by well-being in workplace social networks: Homophily and social contagion. *Emotion, 17*(8), 1166-1180. https://doi.org/10.1037/emo0000311

Chang, V. W., & Christakis, N. A. (2003). Self-perception of weight appropriateness in the United States. *American Journal of Preventive Medicine, 24*(4), 332-339. https://doi.org/https://doi.org/10.1016/S0749-3797(03)00020-5

Cheshire, A., Berry, M., & Fixsen, A. (2020). What are the key features of orthorexia nervosa and influences on its development? A qualitative investigation. *Appetite, 155*, 104798. https://doi.org/https://doi.org/10.1016/j.appet.2020.104798

Christakis, N. A., & Fowler, J. H. (2007). The Spread of Obesity in a Large Social Network over 32 Years. *New England Journal of Medicine, 357*(4), 370-379. https://doi.org/10.1056/NEJMsa066082

Chu, A., H. X. Ng, S., Tan, C. S., M. Win, A., Koh, D., & Mueller-Riemenschneider, F. (2016). *A systematic review and meta-analysis of workplace intervention strategies to reduce sedentary time in white-collar workers* (Vol. 17). https://doi.org/10.1111/obr.12388

Chung, A., Vieira, D., Donley, T., Tan, N., Jean-Louis, G., Gouley, K. K., & Seixas, A. (2021). Adolescent Peer Influence on Eating Behaviors via Social Media: Scoping Review. *JOURNAL OF MEDICAL INTERNET RESEARCH, 23*(6). https://doi.org/10.2196/19697

Church, T. S., Thomas, D. M., Tudor-Locke, C., Katzmarzyk, P. T., Earnest, C. P., Rodarte, R. Q., Martin, C. K., Blair, S. N., & Bouchard, C. (2011). Trends over 5 Decades in U.S. Occupation-Related Physical Activity and Their Associations with Obesity. *PloS one, 6*(5), e19657. https://doi.org/10.1371/journal.pone.0019657

Cialdini, R. B., & Trost, M. R. (1998). Social influence: Social norms, conformity and compliance. In *The handbook of social psychology, Vols. 1-2, 4th ed.* (pp. 151-192). McGraw-Hill.

Clark, A. E., & Oswald, A. J. (1996). Satisfaction and comparison income. *Journal of Public Economics, 61*(3), 359-381. https://doi.org/https://doi.org/10.1016/0047-2727(95)01564-7

Clohessy, S., Walasek, L., & Meyer, C. (2019). Factors influencing employees' eating behaviours in the office-based workplace: A systematic review. *Obesity Reviews, 20*(12), 1771-1780. https://doi.org/10.1111/obr.12920

Clohessy, S., Walasek, L., & Meyer, C. (2021a). Exploring reference group composition when ranking weight with others. *Appetite*, 105572. https://doi.org/https://doi.org/10.1016/j.appet.2021.105572

Clohessy, S., Walasek, L., & Meyer, C. (2021b). Social ranking effects on personal judgements of weight. *Appetite, 157*, 104951. https://doi.org/https://doi.org/10.1016/j.appet.2020.104951

Collins, E. I. M., Thomas, J. M., Robinson, E., Aveyard, P., Jebb, S. A., Herman, P., & Higgs, S. (2018). Two observational studies examining the effect of a social norm and a health

message on the purchase of vegetables in student canteen settings. *Appetite*. https://doi.org/https://doi.org/10.1016/j.appet.2018.09.024

Cornelissen, K. K., Cornelissen, P. L., Hancock, P. J. B., & Tovée, M. J. (2016). Fixation patterns, not clinical diagnosis, predict body size over-estimation in eating disordered women and healthy controls. *International Journal of Eating Disorders, 49*(5), 507-518. https://doi.org/10.1002/eat.22505

Cruwys, T., Bevelander, K. E., & Hermans, R. C. J. (2015). Social modeling of eating: A review of when and why social influence affects food intake and choice. *Appetite, 86*, 3-18. https://doi.org/https://doi.org/10.1016/j.appet.2014.08.035

de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2013). Adolescents' Intake of Junk Food: Processes and Mechanisms Driving Consumption Similarities Among Friends. [https://doi.org/10.1111/jora.12045]. *Journal of Research on Adolescence, 23*(3), 524-536. https://doi.org/https://doi.org/10.1111/jora.12045

Dee, A., Callinan, A., Doherty, E., Neill, C., McVeigh, T., Sweeney, M. R., Staines, A., Kearns, K., Fitzgerald, S., Sharp, L., Kee, F., Hughes, J., Balanda, K., & Perry, I. J. (2015). Overweight and obesity on the island of Ireland: an estimation of costs. [10.1136/bmjopen-2014-006189]. *BMJ open, 5*(3). http://bmjopen.bmj.com/content/5/3/e006189.abstract

Drobnjak, S., Atsiz, S., Ditzen, B., Tuschen-Caffier, B., & Ehlert, U. (2014). Restrained eating and self-esteem in premenopausal and postmenopausal women. *Journal of Eating Disorders, 2*(1), 23-23. https://doi.org/10.1186/s40337-014-0023-1

Elia, C., Karamanos, A., Silva, M. J., O'Connor, M., Lu, Y., Dregan, A., Huang, P., O'Keeffe, M., Cruickshank, J. K., Enayat, E. Z., Cassidy, A., Molaodi, O. R., Maynard, M., & Harding, S. (2020). Weight misperception and psychological symptoms from adolescence to young adulthood: longitudinal study of an ethnically diverse UK cohort. *BMC Public Health, 20*(1), 712. https://doi.org/10.1186/s12889-020-08823-1

Emilien, C., & Hollis, J. H. (2017). A brief review of salient factors influencing adult eating behaviour. *Nutrition Research Reviews, 30*(2), 233-246. https://doi.org/10.1017/S0954422417000099

Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders: Interview or self-report questionnaire? *International Journal of Eating Disorders, 16*(4), 363-370. https://doi.org/10.1002/1098-108x(199412)16:4<363::Aid-eat2260160405>3.0.Co;2-#

Fardouly, J., Pinkus, R. T., & Vartanian, L. R. (2017). The impact of appearance comparisons made through social media, traditional media, and in person in women's everyday lives. *Body Image, 20*, 31-39. https://doi.org/https://doi.org/10.1016/j.bodyim.2016.11.002

Farmer, P., & Stevenson, D. (2017). *Thriving at Work: The Independent Review of Mental Health and Employers.* Retrieved 1st July 2018 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/658145/thriving-at-work-stevenson-farmer-review.pdf

Festinger, L. (1954). A Theory of Social Comparison Processes. *Human Relations, 7*(2), 117-140. https://doi.org/10.1177/001872675400700202

Fitzgerald, S., Kirby, A., Murphy, A., & Geaney, F. (2016). Obesity, diet quality and absenteeism in a working population. *Public Health Nutrition, 19*(18), 3287-3295. https://doi.org/10.1017/S1368980016001269

Fitzsimmons-Craft. (2017). Eating disorder-related social comparison in college women's everyday lives. *The International journal of eating disorders, 50*(8), 893-905. https://doi.org/10.1002/eat.22725

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet Quality and Academic Performance*. *Journal of School Health, 78*(4), 209-215. https://doi.org/doi:10.1111/j.1746-1561.2008.00288.x

Fodor, D. P., Antoni, C. H., Wiedemann, A. U., & Burkert, S. (2014). Healthy eating at different risk levels for job stress: Testing a moderated mediation. *Journal of Occupational Health Psychology, 19*(2), 259-267. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc11&AN=2014-12931-005
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1076-8998&title=Journal+of+Occupational+Health+Psychology&date=2014&atitle=Healthy+eating+at+different+risk+levels+for+job+stress%3A+Testing+a+moderated+mediation.&volume=19&issue=2&spage=259&sid=ovid

Forney, K. J., & Ward, R. M. (2013). Examining the moderating role of social norms between body dissatisfaction and disordered eating in college students. *Eat Behav, 14*(1), 73-78. https://doi.org/10.1016/j.eatbeh.2012.10.017

Freedman, M. R., & Rubinstein, R. J. (2010). Obesity and food choices among faculty and staff at a large urban university. *Journal of American College Health, 59*(3), 205-210. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc7&AN=2011-03610-010
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0744-8481&title=Journal+of+American+College+Health&date=2010&atitle=Obesity+and+food+choices+among+faculty+and+staff+at+a+large+urban+university.&volume=59&issue=3&spage=205&sid=ovid

Galesic, M., Olsson, H., & Rieskamp, J. (2012). Social Sampling Explains Apparent Biases in Judgments of Social Environments. *Psychological Science, 23*(12), 1515-1523. https://doi.org/10.1177/0956797612445313

Galesic, M., Olsson, H., & Rieskamp, J. (2018a). A sampling model of social judgment. *Psychological Review, 125*(3), 363-390. https://doi.org/10.1037/rev0000096

Galesic, M., Olsson, H., & Rieskamp, J. (2018b). A sampling model of social judgment. *Psychological Review, 125*, 363-390. https://doi.org/10.1037/rev0000096

Geaney, Kelly, C., Di Marrazzo, J. S., Harrington, J. M., Fitzgerald, A. P., Greiner, B. A., & Perry, I. J. (2016). The effect of complex workplace dietary interventions on employees' dietary intakes, nutrition knowledge and health status: a cluster controlled trial. *Preventive Medicine, 89*, 76-83. https://doi.org/10.1016/j.ypmed.2016.05.005

Geaney, Kelly, C., Greiner, B., Harrington, J., Perry, I., & Beirne, P. (2013). The effectiveness of workplace dietary modification interventions: A systematic review. *Preventive Medicine: An International Journal Devoted to Practice and Theory, 57*(5), 438-447. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc10&AN=2013-36337-009
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0091-7435&title=Preventive+Medicine%3A+An+International+Journal+Devoted+to+Practice+and+Theory&date=2013&atitle=The+effectiveness+of+workplace+dietary+modification+interventions%3A+A+systematic+review.&volume=57&issue=5&spage=438&sid=ovid

Gerbasi, M. E., Richards, L. K., Thomas, J. J., Agnew-Blais, J. C., Thompson-Brenner, H., Gilman, S. E., & Becker, A. E. (2014). Globalization and eating disorder risk: peer influence, perceived social norms, and adolescent disordered eating in Fiji. *The International journal of eating disorders, 47*(7), 727-737. https://doi.org/10.1002/eat.22349

Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research, 35*(3), 472-482. https://doi.org/10.1086/586910

Gosling, S., Rentfrow, P., & Swann, W. (2003). A Very Brief Measure of the Big-Five Personality Domains. *Journal of Research in Personality, 37*, 504-528. https://doi.org/10.1016/S0092-6566(03)00046-1

Gosse, M. A. (2014). How accurate is self-reported BMI? *Nutrition Bulletin, 39*(1), 105-114. https://doi.org/doi:10.1111/nbu.12075

Grabe, S., Ward, L. M., & Hyde, J. S. (2008). The role of the media in body image concerns among women: A meta-analysis of experimental and correlational studies. *Psychological Bulletin, 134*(3), 460-476. https://doi.org/10.1037/0033-2909.134.3.460

Groesz, L. M., Levine, M. P., & Murnen, S. K. (2002). The effect of experimental presentation of thin media images on body satisfaction: A meta-analytic review. [https://doi.org/10.1002/eat.10005]. *International Journal of Eating Disorders, 31*(1), 1-16. https://doi.org/https://doi.org/10.1002/eat.10005

Hagger-Johnson, G., Carr, E., Murray, E., Stansfeld, S., Shelton, N., Stafford, M., & Head, J. (2017). Association between midlife health behaviours and transitions out of employment from midlife to early old age: Whitehall II cohort study. [Research Support, Non-U.S. Gov't]. *BMC public health, 17*(1), 82. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=medc&AN=28095887
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1471-2458&title=BMC+Public+Health&date=2017&atitle=Association+between+midlife+health+behaviours+and+transitions+out+of+employment+from+midlife+to+early+old+age%3A+Whitehall+II+cohort+study.&volume=17&issue=1&spage=82&sid=ovid

Hajek, P., Przulj, D., Pesola, F., McRobbie, H., Peerbux, S., Phillips-Waller, A., Bisal, N., & Myers Smith, K. (2021). A randomised controlled trial of the 5:2 diet. *PLoS ONE, 16*(11), e0258853. https://doi.org/10.1371/journal.pone.0258853

Harris, C. V., Bradlyn, A. S., Coffman, J., Gunel, E., & Cottrell, L. (2008). BMI-based body size guides for women and men: development and validation of a novel pictorial method to assess weight-related concepts. *International Journal of Obesity, 32*(2), 336-342. https://doi.org/10.1038/sj.ijo.0803704

Hartline-Grafton, H. L., Rose, D., Johnson, C. C., Rice, J. C., & Webber, L. S. (2010). The influence of weekday eating patterns on energy intake and BMI among female elementary school personnel. *Obesity, 18*(4), 736-742. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc7&AN=2010-06883-007
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1930-7381&title=Obesity&date=2010&atitle=The+influence+of+weekday+eating+patterns+on+energy+intake+and+BMI+among+female+elementary+school+personnel.&volume=18&issue=4&spage=736&sid=ovid

Haugaard, P., Stancu, C. M., Brockhoff, P. B., Thorsdottir, I., & Lahteenmaki, L. (2016). Determinants of meal satisfaction in a workplace environment. *Appetite, 105*, 195-203. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc13&AN=2016-39658-024
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0195-6663&title=Appetite&date=2016&atitle=Determinants+of+meal+satisfaction+in+a+workplace+environment.&volume=105&issue=&spage=195&sid=ovid

Hawkins, L. K., Farrow, C., & Thomas, J. M. (2020). Do perceived norms of social media users' eating habits and preferences predict our own food consumption and BMI? *Appetite*, 104611. https://doi.org/https://doi.org/10.1016/j.appet.2020.104611

Haynes, Kersbergen, I., Sutin, A., Daly, M., & Robinson, E. (2018). A systematic review of the relationship between weight status perceptions and weight loss attempts, strategies, behaviours and outcomes. *Obesity reviews : an official journal of the International Association for the Study of Obesity, 19*(3), 347-363. https://doi.org/10.1111/obr.12634

Haynes, A., Kersbergen, I., Sutin, A., Daly, M., & Robinson, E. (2019). Does perceived overweight increase risk of depressive symptoms and suicidality beyond objective weight status? A systematic review and meta-analysis. *Clinical Psychology Review*, 101753. https://doi.org/https://doi.org/10.1016/j.cpr.2019.101753

Health Survey for England. (2017). *"Adult and child overweight and obesity"*.

Health Survey for England. (2019). Overweight and obesity in adults and children report. https://doi.org/https://files.digital.nhs.uk/9D/4195D5/HSE19-Overweight-obesity-rep.pdf

Helson, H. (1964). *Adaptation-level theory: an experimental and systematic approach to behavior*. New York.

Higgs, S. (2015). Social norms and their influence on eating behaviours. *Appetite, 86*, 38-44. https://doi.org/https://doi.org/10.1016/j.appet.2014.10.021

Higgs, S., & Thomas, J. (2016). Social influences on eating. *Current Opinion in Behavioral Sciences, 9*, 1-6. https://doi.org/https://doi.org/10.1016/j.cobeha.2015.10.005

Holland, G., & Tiggemann, M. (2016). A systematic review of the impact of the use of social networking sites on body image and disordered eating outcomes. *Body Image, 17*, 100-110. https://doi.org/https://doi.org/10.1016/j.bodyim.2016.02.008

Hollands, G. J., Cartwright, E., Pilling, M., Pechey, R., Vasiljevic, M., Jebb, S. A., & Marteau, T. M. (2018). Impact of reducing portion sizes in worksite cafeterias: a stepped wedge randomised controlled pilot trial. [journal article]. *International Journal of Behavioral Nutrition and Physical Activity, 15*(1), 78. https://doi.org/10.1186/s12966-018-0705-1

Inoue, M., Toyokawa, S., Inoue, K., Suyama, Y., Miyano, Y., Suzuki, T., Miyoshi, Y., & Kobayashi, Y. (2010). Lifestyle, weight perception and change in body mass index of Japanese workers: MY Health Up Study. *Public Health, 124*(9), 530-537. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc7&AN=2010-19055-009
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0033-3506&title=Public+Health&date=2010&atitle=Lifestyle%2C+weight+perception+and+change+in+body+mass+index+of+Japanese+workers%3A+MY+Health+Up+Study.&volume=124&issue=9&spage=530&sid=ovid
http://www.publichealthjrnl.com/article/S0033-3506(10)00160-5/fulltext

Jackson, S. E., Johnson, F., Croker, H., & Wardle, J. (2015). Weight perceptions in a population sample of English adolescents: cause for celebration or concern? *International Journal of Obesity, 39*(10), 1488-1493. https://doi.org/10.1038/ijo.2015.126

Jastreboff, A. M., Gaiser, E. C., Gu, P., & Sinha, R. (2014). Sex differences in the association between dietary restraint, insulin resistance and obesity. *Eating Behaviors, 15*(2), 286-290. https://doi.org/10.1016/j.eatbeh.2014.03.008

João, L., Sofia, C., & Ada, R. (2018). How do university workers eat at the workplace? *Nutrition & Food Science, 48*(2), 194-205. https://doi.org/doi:10.1108/NFS-07-2017-0141

Johnson-Taylor, W. L., Fisher, R. A., Hubbard, V. S., Starke-Reed, P., & Eggers, P. S. (2008). The change in weight perception of weight status among the overweight: comparison of NHANES III (1988-1994) and 1999-2004 NHANES. *Int J Behav Nutr Phys Act, 5*, 9. https://doi.org/10.1186/1479-5868-5-9

Johnson, F., Beeken, R. J., Croker, H., & Wardle, J. (2014a). Do weight perceptions among obese adults in Great Britain match clinical definitions? Analysis of cross-sectional surveys from 2007 and 2012. *BMJ Open, 4*(11), e005561-e005561. https://doi.org/10.1136/bmjopen-2014-005561

Johnson, F., Beeken, R. J., Croker, H., & Wardle, J. (2014b). Do weight perceptions among obese adults in Great Britain match clinical definitions? Analysis of cross-sectional surveys from 2007 and 2012. *BMJ Open, 4*(11), e005561. https://doi.org/10.1136/bmjopen-2014-005561

Johnson, O. C., Carlson, J. B., Veverka, D. V., & Self, B. P. (2007). Research Article: Effects of low blood glucose on pilot performance. *BIOS, 78*(3), 95-100. https://doi.org/10.1893/0005-3155(2007)78[95:EOLBGO]2.0.CO;2

Jones, A. R., Parkinson, K. N., Drewett, R. F., Hyland, R. M., Pearce, M. S., & Adamson, A. J. (2011). Parental perceptions of weight status in children: the Gateshead Millennium Study. *Int J Obes (Lond), 35*(7), 953-962. https://doi.org/10.1038/ijo.2011.106

Kim, H., Callan, M. J., Gheorghiu, A. I., & Skylark, W. J. (2018). Social comparison processes in the experience of personal relative deprivation. *Journal of Applied Social Psychology, 48*(9), 519-532. https://doi.org/10.1111/jasp.12531

Kuang, J., Thulin, E., Ashraf, S., Shpenev, A., Das, U., Delea, M. G., McNally, P., & Bicchieri, C. (2020). Bias in the perceived prevalence of open defecation: Evidence from Bihar, India. *PLoS ONE, 15*(9), e0238627. https://doi.org/10.1371/journal.pone.0238627

Kyle, R. G., Wills, J., Mahoney, C., Hoyle, L., Kelly, M., & Atherton, I. M. (2017). Obesity prevalence among healthcare professionals in England: a cross-sectional study using the Health Survey for England. [10.1136/bmjopen-2017-018498]. *BMJ open, 7*(12). http://bmjopen.bmj.com/content/7/12/e018498.abstract

Lake, A. A., Smith, S. A., Bryant, C. E., Alinia, S., Brandt, K., Seal, C. J., & Tetens, I. (2016). Exploring the dynamics of a free fruit at work intervention. *BMC Public Health, 16*(1), 839.

Lamport, D. J., Wu, S.-Y., Drever-Heaps, J., Hugueniot, O., Jones, D. J. W., Kennedy, O. B., Williams, C. M., & Butler, L. T. (2021). Can Public Health Interventions Change Immediate and Long-Term Dietary Behaviours? Encouraging Evidence from a Pilot Study of the U.K. Change4Life Sugar Swaps Campaign. *Nutrients, 14*(1), 68. https://doi.org/10.3390/nu14010068

Lang, B., Ahlich, E., Verzijl, C. L., Thompson, J. K., & Rancourt, D. (2019). The role of drive for thinness in the association between weight status misperception and disordered eating. *Eating Behaviors, 35*, 101319. https://doi.org/https://doi.org/10.1016/j.eatbeh.2019.101319

Lasi, H., Fettke, P., Kemper, H.-G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. [journal article]. *Business & Information Systems Engineering, 6*(4), 239-242. https://doi.org/10.1007/s12599-014-0334-4

Legros, S., & Cislaghi, B. (2020). Mapping the Social-Norms Literature: An Overview of Reviews. *Perspectives on Psychological Science, 15*(1), 62-80. https://doi.org/10.1177/1745691619866455

Leidy, H. J., & Campbell, W. W. (2011). The Effect of Eating Frequency on Appetite Control and Food Intake: Brief Synopsis of Controlled Feeding Studies. *The Journal of Nutrition, 141*(1), 154-157. https://doi.org/10.3945/jn.109.114389

Lewallen, J., & Behm-Morawitz, E. (2016). Pinterest or Thinterest?: Social Comparison and Body Image on Social Media. *Social Media + Society, 2*(1), 2056305116640559. https://doi.org/10.1177/2056305116640559

Lewis, D. W., Dutton, G. R., & Affuso, O. (2015). Physical characteristics associated with weight misperception among overweight and obese men: NHANES 1999-2006. *Obesity (Silver Spring, Md.), 23*(1), 242-247. https://doi.org/10.1002/oby.20930

Lima, J., Costa, S., & Rocha, A. (2018). How do university workers eat at the workplace? *Nutrition & Food Science, 48*(2), 194-205. https://doi.org/10.1108/NFS-07-2017-0141

Lindberg, C. M., Srinivasan, K., Gilligan, B., Razjouyan, J., Lee, H., Najafi, B., Canada, K. J., Mehl, M. R., Currim, F., Ram, S., Lunden, M. M., Heerwagen, J. H., Kampschroer, K., & Sternberg, E. M. (2018). Effects of office workstation type on physical activity and stress. *Occupational and environmental medicine, 75*(10), 689. https://doi.org/10.1136/oemed-2018-105077

Lindseth, G. N., Lindseth, P. D., Jensen, W. C., Petros, T. V., Helland, B. D., & Fossum, D. L. (2011). Dietary Effects on Cognition and Pilots' Flight Performance. *The International Journal of Aviation Psychology, 21*(3), 269-282. https://doi.org/10.1080/10508414.2011.582454

Littlewood, D., Kyle, S. D., Pratt, D., Peters, S., & Gooding, P. (2017). Examining the role of psychological factors in the relationship between sleep problems and suicide. *Clinical Psychology Review, 54*, 1-16. https://doi.org/10.1016/j.cpr.2017.03.009

Lundahl, A., Kidwell, K. M., & Nelson, T. D. (2014). Parental Underestimates of Child Weight: A Meta-analysis. *Pediatrics, 133*(3), e689. https://doi.org/10.1542/peds.2013-2690

Mabe, A. G., Forney, K. J., & Keel, P. K. (2014). Do you "like" my photo? Facebook use maintains eating disorder risk. [https://doi.org/10.1002/eat.22254]. *International Journal of Eating Disorders, 47*(5), 516-523. https://doi.org/https://doi.org/10.1002/eat.22254

Macchia, L., Plagnol, A. C., & Powdthavee, N. (2020). Buying Happiness in an Unequal World: Rank of Income More Strongly Predicts Well-Being in More Unequal Countries. *Personality and Social Psychology Bulletin, 46*(5), 769-780. https://doi.org/10.1177/0146167219877413

Maltby, J., Paterson, K., Day, L., Jones, C., Kinnear, H., & Buchanan, H. (2016). Social ranking effects on tooth-brushing behaviour. *British Journal of Health Psychology, 21*(2), 374-388. https://doi.org/10.1111/bjhp.12173

Maltby, J., Wood, A. M., Vlaev, I., Taylor, M. J., & Brown, G. D. A. (2012). Contextual Effects on the Perceived Health Benefits of Exercise: The Exercise Rank Hypothesis. *Journal of Sport and Exercise Psychology, 34*(6), 828-841. https://doi.org/10.1123/jsep.34.6.828

Maximova, K., McGrath, J. J., Barnett, T., O'Loughlin, J., Paradis, G., & Lambert, M. (2008). Do you see what I see? Weight status misperception and exposure to obesity among children and adolescents. *International Journal of Obesity, 32*(6), 1008-1015. https://doi.org/10.1038/ijo.2008.15

Mazzola, J. J., Moore, J., & Alexander, K. (2017). Is work keeping us from acting healthy? How workplace barriers and facilitators impact nutrition and exercise behaviors. *Stress and Health: Journal of the International Society for the Investigation of Stress, 33*(5), 479-489. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc13&AN=2016-57852-001
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1532-3005&title=Stress+and+Health%3A+Journal+of+the+International+Society+for+the+Inv

estigation+of+Stress&date=2017&atitle=Is+work+keeping+us+from+acting+healthy%3F+How+workplace+barriers+and+facilitators+impact+nutrition+and+exercise+behaviors.&volume=33&issue=5&spage=479&sid=ovid

Melrose, K. L., Brown, G. D. A., & Wood, A. M. (2013). Am I Abnormal? Relative Rank and Social Norm Effects in Judgments of Anxiety and Depression Symptom Severity. *Journal of Behavioral Decision Making, 26*(2), 174-184. https://doi.org/doi:10.1002/bdm.1754

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS medicine, 6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Moore, S. C., Wood, A. M., Moore, L., Shepherd, J., Murphy, S., & Brown, G. D. A. (2016). A rank based social norms model of how people judge their levels of drunkenness whilst intoxicated. [journal article]. *BMC Public Health, 16*(1), 798. https://doi.org/10.1186/s12889-016-3469-z

Moorman, E. L., Warnick, J. L., Acharya, R., & Janicke, D. M. (2020). The use of internet sources for nutritional information is linked to weight perception and disordered eating in young adolescents. *Appetite, 154*, 104782. https://doi.org/https://doi.org/10.1016/j.appet.2020.104782

Muttarak, R. (2018). Normalization of Plus Size and the Danger of Unseen Overweight and Obesity in England. *Obesity (Silver Spring, Md.), 26*(7), 1125-1129. https://doi.org/10.1002/oby.22204

Narayan, K. M. V., & Kanaya, A. M. (2020). Why are South Asians prone to type 2 diabetes? A hypothesis based on underexplored pathways. *Diabetologia, 63*(6), 1103-1109. https://doi.org/10.1007/s00125-020-05132-5

Nicholls, R., Perry, L., Duffield, C., Gallagher, R., & Pierce, H. (2017). Barriers and facilitators to healthy eating for nurses in the workplace: an integrative review. *Journal of Advanced Nursing, 73*(5), 1051-1065. https://doi.org/https://doi.org/10.1111/jan.13185

Nuttall, F. Q. (2015). Body Mass Index: Obesity, BMI, and Health: A Critical Review. *Nutrition today, 50*(3), 117-128. https://doi.org/10.1097/NT.0000000000000092

Nyberg, S. T., Batty, G. D., Pentti, J., Virtanen, M., Alfredsson, L., Fransson, E. I., Goldberg, M., Heikkilä, K., Jokela, M., Knutsson, A., Koskenvuo, M., Lallukka, T., Leineweber, C., Lindbohm, J. V., Madsen, I. E. H., Magnusson Hanson, L. L., Nordin, M., Oksanen, T., Pietiläinen, O., Rahkonen, O., Rugulies, R., Shipley, M. J., Stenholm, S., Suominen, S., Theorell, T., Vahtera, J., Westerholm, P. J. M., Westerlund, H., Zins, M., Hamer, M., Singh-Manoux, A., Bell, J. A., Ferrie, J. E., & Kivimäki, M. (2018). Obesity and loss of disease-free years owing to major non-communicable diseases: a multicohort study. *The Lancet Public Health*. https://doi.org/10.1016/S2468-2667(18)30139-7

O'Malley, A. J., & Christakis, N. A. (2011). Longitudinal analysis of large social networks: estimating the effect of health traits on changes in friendship ties. *Statistics in medicine, 30*(9), 950-964. https://doi.org/10.1002/sim.4190

Oldham, M., & Robinson, E. (2015). Visual weight status misperceptions of men: Why overweight can look like a healthy weight. *Journal of Health Psychology, 21*(8), 1768-1777. https://doi.org/10.1177/1359105314566257

Oldham, M., & Robinson, E. (2017). Visual body size norms and the under-detection of overweight and obesity. *Obesity science & practice, 4*(1), 29-40. https://doi.org/10.1002/osp4.143

ONS. (2016). *A Government Statistical Service perspective on official estimates of calorie consumption*. Retrieved 20th August 2018 from https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/methodologies/agovernmentstatisticalserviceperspectiveonofficialestimatesofcalorieconsumption

ONS. (2018). *UK Labour Market: June 2018*. Retrieved 1st July 2018 from https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/june2018#actual-hours-worked

Pachucki, M. A., Jacques, P. F., & Christakis, N. A. (2011). Social network concordance in food choice among spouses, friends, and siblings. *American Journal of Public Health, 101*(11), 2170-2177. https://doi.org/10.2105/AJPH.2011.300282

Palan, S., & Schitter, C. (2018). Prolific.ac—A subject pool for online experiments. *Journal of Behavioral and Experimental Finance, 17*, 22-27. https://doi.org/https://doi.org/10.1016/j.jbef.2017.12.004

Parducci, A. (1965). Category judgment: A range-frequency model. *Psychological Review, 72*(6), 407-418. https://doi.org/10.1037/h0022602

Park, D., Lee, J.-H., & Han, S. (2017a). Underweight: another risk factor for cardiovascular disease?: A cross-sectional 2013 Behavioral Risk Factor Surveillance System (BRFSS) study of 491,773 individuals in the USA. *MEDICINE, 96*(48). https://journals.lww.com/md-journal/Fulltext/2017/12010/Underweight__another_risk_factor_for.32.aspx

Park, S., Sung, E., Choi, Y., Ryu, S., Chang, Y., & Gittelsohn, J. (2017b). Sociocultural Factors Influencing Eating Practices Among Office Workers in Urban South Korea. *Journal of Nutrition Education & Behavior, 49*(6), 466-474.e461. https://doi.org/10.1016/j.jneb.2017.02.005

Parry, D., Oeppen, R. S., Gass, H., & Brennan, P. A. (2017). Impact of hydration and nutrition on personal performance in the clinical workplace. *British Journal of Oral and Maxillofacial Surgery, 55*(10), 995-998. https://doi.org/https://doi.org/10.1016/j.bjoms.2017.10.017

Payne, N., Jones, F., & Harris, P. R. (2013). Employees' perceptions of the impact of work on health behaviours. *Journal of Health Psychology, 18*(7), 887-899. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc10&AN=2013-22519-004
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1359-1053&title=Journal+of+Health+Psychology&date=2013&atitle=Employees%27+percep

tions+of+the+impact+of+work+on+health+behaviours.&volume=18&issue=7&spage=887&sid=ovid

Perkins, H. W. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol, Supplement*(s14), 164-172. https://doi.org/10.15288/jsas.2002.s14.164

Perkins, J., Perkins, H., & Craig, D. (2010). Peer weight norm misperception as a risk factor for being over and underweight among UK secondary school students. *European Journal of Clinical Nutrition, 64*(9), 965-971.

Pilař, L., Stanislavská, L. K., Kvasnička, R., Hartman, R., & Tichá, I. (2021). Healthy Food on Instagram Social Network: Vegan, Homemade and Clean Eating. *Nutrients, 13*(6). https://doi.org/10.3390/nu13061991

Polivy, J. (1996). Psychological Consequences of Food Restriction. *Journal of the American Dietetic Association, 96*(6), 589-592. https://doi.org/https://doi.org/10.1016/S0002-8223(96)00161-7

Polivy, J. (2017). What's that you're eating? Social comparison and eating behavior. [journal article]. *Journal of Eating Disorders, 5*(1), 18. https://doi.org/10.1186/s40337-017-0148-0

Polivy, J., & Herman, C. P. (1985). Dieting and binging: A causal analysis. *American Psychologist, 40*(2), 193-201. https://doi.org/10.1037/0003-066X.40.2.193

Polivy, J., Herman, C. P., & Mills, J. S. (2020). What is restrained eating and how do we identify it? *Appetite, 155*, 104820. https://doi.org/https://doi.org/10.1016/j.appet.2020.104820

Polivy, J., & Pliner, P. (2015). "She got more than me". Social comparison and the social context of eating. *Appetite, 86*, 88-95. https://doi.org/https://doi.org/10.1016/j.appet.2014.08.007

Popay, J., Roberts, H. M., Sowden, A. J., Petticrew, M., Arai, L., Rodgers, M., & Britten, N. (2006). Guidance on the conduct of narrative synthesis in systematic Reviews. A Product from the ESRC Methods Programme. Version 1.

Pridgeon, A., & Whitehead, K. (2013). A qualitative study to investigate the drivers and barriers to healthy eating in two public sector workplaces. *Journal of Human Nutrition & Dietetics, 26*(1), 85-95. https://doi.org/10.1111/j.1365-277X.2012.01281.x

Prinsen, S., de Ridder, D. T. D., & de Vet, E. (2013). Eating by example. Effects of environmental cues on dietary decisions. *Appetite, 70*, 1-5. https://doi.org/https://doi.org/10.1016/j.appet.2013.05.023

Public Health England. (2017). *Making Obesity everybody's business: a whole systems approach to obesity*. https://www.local.gov.uk/sites/default/files/documents/15.6%20Obesity-05.pdf

Pujades, S., Mohler, B., Thaler, A., Tesch, J., Mahmood, N., Hesse, N., Bülthoff, H. H., & Black, M. J. (2019). The Virtual Caliper: Rapid Creation of Metrically Accurate Avatars from 3D

Measurements. *IEEE Transactions on Visualization and Computer Graphics, 25*(5), 1887-1897. https://doi.org/10.1109/TVCG.2019.2898748

Putnam-Farr, E., & Morewedge, C. (2019). *Comparing One and Many: Insights From Judgment and Decision-Making for Social Comparison*.

Putnam-Farr, E., & Morewedge, C. (2020). *Which Social Comparisons Influence Happiness with Unequal Pay?* https://doi.org/10.1037/xge0000965

Quintana-Domeque, C., & Wohlfart, J. (2016). "Relative concerns for consumption at the top": An intertemporal analysis for the UK. *Journal of Economic Behavior & Organization, 129*(C), 172-194. https://EconPapers.repec.org/RePEc:eee:jeborg:v:129:y:2016:i:c:p:172-194

Quispe-Torreblanca, E. G., Brown, G. D. A., Boyce, C. J., Wood, A. M., & De Neve, J.-E. Inequality and Social Rank: Income Increases Buy More Life Satisfaction in More Equal Countries. *Personality and Social Psychology Bulletin, 0*(0), 0146167220923853. https://doi.org/10.1177/0146167220923853

Racine, S. E., Burt, S. A., Iacono, W. G., McGue, M., & Klump, K. L. (2011). Dietary restraint moderates genetic risk for binge eating. *Journal of Abnormal Psychology, 120*(1), 119-128. https://doi.org/10.1037/a0020895

Ramirez, J. C., & Milan, S. (2016). Perceived size of friends and weight evaluation among low-income adolescents. *Journal of behavioral medicine, 39*(2), 334-345. https://doi.org/10.1007/s10865-015-9682-x

Rancourt, D., Leahey, T. M., LaRose, J. G., & Crowther, J. H. (2015). Effects of weight-focused social comparisons on diet and activity outcomes in overweight and obese young women. *Obesity (Silver Spring, Md.), 23*(1), 85-89. https://doi.org/10.1002/oby.20953

Robinson. (2017). Overweight but unseen: a review of the underestimation of weight status and a visual normalization theory. *Obesity Reviews, 18*(10), 1200-1209. https://doi.org/10.1111/obr.12570

Robinson, & Kersbergen. (2017). Overweight or about right? A norm comparison explanation of perceived weight status. *Obesity science & practice, 3*(1), 36-43. https://doi.org/10.1002/osp4.89

Robinson, & Oldham. (2016). Weight status misperceptions among UK adults: the use of self-reported vs. measured BMI. [journal article]. *BMC Obesity, 3*(1), 21. https://doi.org/10.1186/s40608-016-0102-8

Robinson, Parretti, H., & Aveyard, P. (2014). Visual identification of obesity by healthcare professionals: an experimental study of trainee and qualified GPs. *Br J Gen Pract, 64*(628), e703-708. https://doi.org/10.3399/bjgp14X682285

Robinson, E., Benwell, H., & Higgs, S. (2013). Food intake norms increase and decrease snack food intake in a remote confederate study. *Appetite, 65*, 20-24. https://doi.org/https://doi.org/10.1016/j.appet.2013.01.010

Robinson, E., & Hogenkamp, P. S. (2015). Visual perceptions of male obesity: a cross-cultural study examining male and female lay perceptions of obesity in Caucasian males. *BMC Public Health, 15*, 492-492. https://doi.org/10.1186/s12889-015-1821-3

Rollings, K. A., & Wells, N. M. (2017). Effects of Floor Plan Openness on Eating Behaviors. *Environment and Behavior, 49*(6), 663-684. https://doi.org/10.1177/0013916516661822

Rosa, C., Marsch, L. A., Winstanley, E. L., Brunner, M., & Campbell, A. N. C. (2021). Using digital technologies in clinical trials: Current and future applications. *Contemp Clin Trials, 100*, 106219. https://doi.org/10.1016/j.cct.2020.106219

Ross, R., Neeland, I. J., Yamashita, S., Shai, I., Seidell, J., Magni, P., Santos, R. D., Arsenault, B., Cuevas, A., Hu, F. B., Griffin, B. A., Zambon, A., Barter, P., Fruchart, J.-C., Eckel, R. H., Matsuzawa, Y., & Després, J.-P. (2020). Waist circumference as a vital sign in clinical practice: a Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity. *Nature Reviews Endocrinology, 16*(3), 177-189. https://doi.org/10.1038/s41574-019-0310-7

Rounsefell, K., Gibson, S., McLean, S., Blair, M., Molenaar, A., Brennan, L., Truby, H., & McCaffrey, T. A. (2020). Social media, body image and food choices in healthy young adults: A mixed methods systematic review. *NUTRITION & DIETETICS, 77*(1), 19-40. https://doi.org/10.1111/1747-0080.12581

Ruddock, H. K., Brunstrom, J. M., & Higgs, S. (2021). The social facilitation of eating: why does the mere presence of others cause an increase in energy intake? *PHYSIOLOGY & BEHAVIOR, 240*. https://doi.org/10.1016/j.physbeh.2021.113539

Russell, J. A., & Fehr, B. (1987). Relativity in the perception of emotion in facial expressions. *Journal of Experimental Psychology: General, 116*, 223-237. https://doi.org/10.1037/0096-3445.116.3.223

Salathé, M., & Khandelwal, S. (2011). Assessing Vaccination Sentiments with Online Social Media: Implications for Infectious Disease Dynamics and Control. *PLOS Computational Biology, 7*(10), e1002199. https://doi.org/10.1371/journal.pcbi.1002199

Schaumberg, K., Anderson, D. A., Anderson, L. M., Reilly, E. E., & Gorrell, S. (2016a). Dietary restraint: what's the harm? A review of the relationship between dietary restraint, weight trajectory and the development of eating pathology. [https://doi.org/10.1111/cob.12134]. *Clinical Obesity, 6*(2), 89-100. https://doi.org/https://doi.org/10.1111/cob.12134

Schaumberg, K., Anderson, D. A., Anderson, L. M., Reilly, E. E., & Gorrell, S. (2016b). Dietary restraint: what's the harm? A review of the relationship between dietary restraint, weight trajectory and the development of eating pathology. *Clin Obes, 6*(2), 89-100. https://doi.org/10.1111/cob.12134

Setto, J. M., de Fátima Bonolo, P., & Castro Franceschini, S. d. C. (2016). Relationship between health behaviors and self-reported diseases by public employees. *Fisioterapia em Movimento, 29*(3), 477-485. https://doi.org/10.1590/0103-5150.029.003.AO05

Sforzo, G. A., Kay, M. P., Calleri, D., & Ngai, N. (2012). Free Choice Access to Multipoint Wellness Education and Related Services Positively Impacts Employee Wellness A Randomized and Controlled Trial. *Journal of Occupational & Environmental Medicine, 54*(4), 471-477. https://doi.org/10.1097/JOM.ObO 13e3182479f5c

Sharps, M. A., Fallon, V., Ryan, S., & Coulthard, H. (2021). The role of perceived descriptive and injunctive norms on the self-reported frequency of meat and plant-based meal intake in UK-based adults. *Appetite, 167*, 105615. https://doi.org/10.1016/j.appet.2021.105615

Simon, G. E., Von Korff, M., Saunders, K., Miglioretti, D. L., Crane, P. K., Van Belle, G., & Kessler, R. C. (2006). Association between obesity and psychiatric disorders in the US adult population. *Archives of general psychiatry, 63*(7), 824-830.

Slater, A., Cole, N., & Fardouly, J. (2019). The effect of exposure to parodies of thin-ideal images on young women's body image and mood. *Body Image, 29*, 82-89. https://doi.org/https://doi.org/10.1016/j.bodyim.2019.03.001

Slater, A., Varsani, N., & Diedrichs, P. C. (2017). #fitspo or #loveyourself? The impact of fitspiration and self-compassion Instagram images on women's body image, self-compassion, and mood. *Body Image, 22*, 87-96. https://doi.org/https://doi.org/10.1016/j.bodyim.2017.06.004

Smedslund, G., Fisher, K., Boles, S., & Lichtenstein, E. (2004). The effectiveness of workplace smoking cessation programmes: a meta-analysis of recent studies. *Tobacco Control, 13*(2), 197-204. https://doi.org/10.1136/tc.2002.002915

Smith, S. A., Lake, A. A., Summerbell, C., Araujo-Soares, V., & Hillier-Brown, F. (2016). The effectiveness of workplace dietary interventions: protocol for a systematic review and meta-analysis. *Systematic Reviews, 5*, 20. https://doi.org/10.1186/s13643-016-0200-1

Sonnentag, S., Pundt, A., & Venz, L. (2017). Distal and proximal predictors of snacking at work: A daily-survey study. *Journal of Applied Psychology, 102*(2), 151-162. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc13&AN=2016-49316-001
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0021-9010&title=Journal+of+Applied+Psychology&date=2017&atitle=Distal+and+proximal+predictors+of+snacking+at+work%3A+A+daily-survey+study.&volume=102&issue=2&spage=151&sid=ovid

Sonneville, K. R., Thurston, I. B., Milliren, C. E., Gooding, H. C., & Richmond, T. K. (2016). Weight misperception among young adults with overweight/obesity associated with disordered eating behaviors. *International Journal of Eating Disorders, 49*(10), 937-946. https://doi.org/10.1002/eat.22565

Stewart, N., Chater, N., & Brown, G. D. A. (2006). Decision by sampling. *Cognitive Psychology, 53*(1), 1-26. https://doi.org/https://doi.org/10.1016/j.cogpsych.2005.10.003

Tabak, R. G., Hipp, J. A., Marx, C. M., & Brownson, R. C. (2015). Workplace social and organizational environments and healthy-weight behaviors. [Research Support, N.I.H., Extramural
Research Support, Non-U.S. Gov't

Research Support, U.S. Gov't, P.H.S.]. *PLoS ONE [Electronic Resource], 10*(4), e0125424. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med8&AN=25919659
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1932-6203&title=PLoS+ONE+%5BElectronic+Resource%5D&date=2015&atitle=Workplace+social+and+organizational+environments+and+healthy-weight+behaviors.&volume=10&issue=4&spage=e0125424&sid=ovid

Tamers, S. L., Thompson, B., Cheadle, A. D., Zheng, Y., Bishop, S. K., & Beresford, S. A. A. (2015). Promoting Changes in Obesogenic Behaviors: Does Coworker Social Support Play a Role? *American Journal of Health Promotion, 29*(5), 311-313. https://doi.org/10.4278/ajhp.130709-ARB-352

Thaler, A., Geuss, M. N., Mölbert, S. C., Giel, K. E., Streuber, S., Romero, J., Black, M. J., & Mohler, B. J. (2018). Body size estimation of self and others in females varying in BMI. *PLoS ONE, 13*(2), e0192152. https://doi.org/10.1371/journal.pone.0192152

Thomas, J. M., Ursell, A., Robinson, E. L., Aveyard, P., Jebb, S. A., Herman, C., & Higgs, S. (2017). Using a descriptive social norm to increase vegetable selection in workplace restaurant settings. *Health Psychology, 36*(11), 1026-1033. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc13&AN=2017-23179-001
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0278-6133&title=Health+Psychology&date=2017&atitle=Using+a+descriptive+social+norm+to+increase+vegetable+selection+in+workplace+restaurant+settings.&volume=36&issue=11&spage=1026&sid=ovid

Thorsen, A. V., Lassen, A. D., Tetens, I., Hels, O., Mikkelsen, B. E., Thorsen, A. V., Lassen, A. D., Tetens, I., Hels, O., & Mikkelsen, B. E. (2010). Long-term sustainability of a worksite canteen intervention of serving more fruit and vegetables. *Public Health Nutrition, 13*(10), 1647-1652. https://doi.org/10.1017/S1368980010001242

Tsiga, E., Panagopoulou, E., & Niakas, D. (2015). Health promotion across occupational groups: One size does not fit all. *Occupational Medicine, 65*(7), 552-557. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc12&AN=2015-42712-006
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0962-7480&title=Occupational+Medicine&date=2015&atitle=Health+promotion+across+occupational+groups%3A+One+size+does+not+fit+all.&volume=65&issue=7&spage=552&sid=ovid

Turner, P. G., & Lefevre, C. E. (2017). Instagram use is linked to increased symptoms of orthorexia nervosa. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity, 22*(2), 277-284. https://doi.org/10.1007/s40519-017-0364-2

van Strien, T., & Koenders, P. (2011). Restrained eating is related to augmented overweight-associated absenteeism in a prospective study. *Journal of Occupational and Environmental Medicine, 53*(6), 663-668. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc8&AN=2011-12027-006
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1076-2752&title=Journal+of+Occupational+and+Environmental+Medicine&date=2011&atitl

e=Restrained+eating+is+related+to+augmented+overweight-associated+absenteeism+in+a+prospective+study.&volume=53&issue=6&spage=663&sid=ovid
https://insights.ovid.com/pubmed?pmid=21654438

van Strien, T., & Koenders, P. G. (2012). How do life style factors relate to general health and overweight? *Appetite, 58*(1), 265-270. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc9&AN=2012-02176-040
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0195-6663&title=Appetite&date=2012&atitle=How+do+life+style+factors+relate+to+general+health+and+overweight%3F&volume=58&issue=1&spage=265&sid=ovid

VanEpps, E. M., Downs, J. S., & Loewenstein, G. (2016a). Advance ordering for healthier eating? Field experiments on the relationship between the meal order-Consumption time delay and meal content. *Journal of Marketing Research, 53*(3), 369-380. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc13&AN=2016-28717-005
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0022-2437&title=Journal+of+Marketing+Research&date=2016&atitle=Advance+ordering+for+healthier+eating%3F+Field+experiments+on+the+relationship+between+the+meal+order-Consumption+time+delay+and+meal+content.&volume=53&issue=3&spage=369&sid=ovid

VanEpps, E. M., Downs, J. S., & Loewenstein, G. (2016b). Calorie Label Formats: Using Numeric and Traffic Light Calorie Labels to Reduce Lunch Calories. *Journal of Public Policy & Marketing, 35*(1), 26-36. https://doi.org/10.1509/jppm.14.112

Vartanian, L. R., & Germeroth, L. J. (2011). Accuracy in estimating the body weight of self and others: Impact of dietary restraint and BMI. *Body Image, 8*(4), 415-418. https://doi.org/https://doi.org/10.1016/j.bodyim.2011.06.007

Vasiljevic, M., Cartwright, E., Pechey, R., Hollands, G. J., Couturier, D.-L., Jebb, S. A., & Marteau, T. M. (2017). Physical micro-environment interventions for healthier eating in the workplace: protocol for a stepped wedge randomised controlled pilot trial. *Pilot and Feasibility Studies, 3*, 27. https://doi.org/10.1186/s40814-017-0141-z

Vasiljevic, M., Cartwright, E., Pilling, M., Lee, M.-M., Bignardi, G., Pechey, R., Hollands, G. J., Jebb, S. A., & Marteau, T. M. (2018). Impact of calorie labelling in worksite cafeterias: a stepped wedge randomised controlled pilot trial. [journal article]. *International Journal of Behavioral Nutrition and Physical Activity, 15*(1), 41. https://doi.org/10.1186/s12966-018-0671-7

Ventola, C. L. (2014). Social media and health care professionals: benefits, risks, and best practices. *P & T : a peer-reviewed journal for formulary management, 39 7*, 491-520.

Vyth, E. L., Steenhuis, I. H., Heymans, M. W., Roodenburg, A. J., Brug, J., & Seidell, J. C. (2011). Influence of placement of a nutrition logo on cafeteria menu items on lunchtime food Choices at Dutch work sites. [Multicenter Study
Randomized Controlled Trial

Research Support, Non-U.S. Gov't]. *Journal of the American Dietetic Association, 111*(1), 131-136. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med7&AN=21185975
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=0002-8223&title=Journal+of+the+American+Dietetic+Association&date=2011&atitle=Influence+of+placement+of+a+nutrition+logo+on+cafeteria+menu+items+on+lunchtime+food+Choices+at+Dutch+work+sites.&volume=111&issue=1&spage=131&sid=ovid

Wainberg, M., Mahajan, A., Kundaje, A., McCarthy, M. I., Ingelsson, E., Sinnott-Armstrong, N., & Rivas, M. A. (2019). Homogeneity in the association of body mass index with type 2 diabetes across the UK Biobank: A Mendelian randomization study. *PLOS Medicine, 16*(12), e1002982. https://doi.org/10.1371/journal.pmed.1002982

Wang, M. L., Pbert, L., & Lemon, S. C. (2014). Influence of family, friend and coworker social support and social undermining on weight gain prevention among adults. *Obesity, 22*(9), 1973-1980. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc11&AN=2014-36303-009
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1930-7381&title=Obesity&date=2014&atitle=Influence+of+family%2C+friend+and+coworker+social+support+and+social+undermining+on+weight+gain+prevention+among+adults.&volume=22&issue=9&spage=1973&sid=ovid
https://onlinelibrary.wiley.com/doi/pdf/10.1002/oby.20814

Webber, C., Blissett, J., Addessi, E., Galloway, A. T., Shapiro, L., & Farrow, C. (2021). An infant-led approach to complementary feeding is positively associated with language development. [https://doi.org/10.1111/mcn.13206]. *Maternal & Child Nutrition, 17*(4), e13206. https://doi.org/https://doi.org/10.1111/mcn.13206

Wedell, D. H., Santoyo, E. M., & Pettibone, J. C. (2005). The Thick and the Thin of It: Contextual Effects in Body Perception. *Basic and Applied Social Psychology, 27*(3), 213-227. https://doi.org/10.1207/s15324834basp2703_3

Weijzen, P. L. G., de Graaf, C., & Dijksterhuis, G. B. (2008). Discrepancy between snack choice intentions and behavior. *Journal of Nutrition Education & Behavior, 40*(5), 311-316. http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=105554094&site=ehost-live

Wilksch, S. M., O'Shea, A., Ho, P., Byrne, S., & Wade, T. D. (2020). The relationship between social media use and disordered eating in young adolescents. *International Journal of Eating Disorders, 53*(1), 96-106. https://doi.org/10.1002/eat.23198

Wood, A. M., Brown, G. D. A., & Maltby, J. (2011). Social Norm Influences on Evaluations of the Risks Associated with Alcohol Consumption: Applying the Rank-Based Decision by Sampling Model to Health Judgments. *Alcohol and Alcoholism, 47*(1), 57-62. https://doi.org/10.1093/alcalc/agr146

Wood, A. M., Brown, G. D. A., Maltby, J., & Watkinson, P. (2012). How Are Personality Judgments Made? A Cognitive Model of Reference Group Effects, Personality Scale Responses, and Behavioral Reactions. *Journal of Personality, 80*(5), 1275-1311. https://doi.org/10.1111/j.1467-6494.2012.00763.x

Yaemsiri, S., Slining, M. M., & Agarwal, S. K. (2011). Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. *International Journal of Obesity, 35*(8), 1063-1070. https://doi.org/10.1038/ijo.2010.229

Yeo, G. S. H. (2022). Is calorie labelling on menus the solution to obesity? *Nature Reviews Endocrinology, 18*(8), 453-454. https://doi.org/10.1038/s41574-022-00705-3

Yoon, C., Jung, H., & Kim, Y. (2011). Evaluation of an incentive-based obesity management program in a workplace. *International Journal of Occupational Safety & Ergonomics, 17*(2), 147-154. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=med7&AN=21679666
http://pugwash.lib.warwick.ac.uk:4550/resserv?genre=article&issn=1080-3548&title=International+Journal+of+Occupational+Safety+%26+Ergonomics&date=2011&atitle=Evaluation+of+an+incentive-based+obesity+management+program+in+a+workplace.&volume=17&issue=2&spage=147&sid=ovid

Zhu, D. Q., Norman, I. J., & While, A. E. (2011). The relationship between doctors' and nurses' own weight status and their weight management practices: a systematic review. *Obesity Reviews, 12*(6), 459-469. https://doi.org/10.1111/j.1467-789X.2010.00821.x

Zunker, C., Cox, T. L., Wingo, B. C., Knight, B., Jefferson, W. K., & Ard, J. D. (2008). Using formative research to develop a worksite health promotion program for African American women. *Women & Health, 48*(2), 189-207. http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=105568242&site=ehost-live

Appendix 1 *Systematic review search strategy*

Database	Search terms	Limiters
CINAHL	(workplace* or "work place*" or "work site" or worksite or work or employee*) AND (“eating behavio?r*” or diet or eating).	Published date (2008-2018), English Language, peer reviewed, human participants.
MEDLINE	(workplace* or "work place*" or "work site" or worksite or work or employee*) ti, ab, kw. AND (“eating behavio?r*” or diet or eating) ti, ab, kw.	Published date (2008-2018), English Language, peer reviewed, human participants.
PsycINFO	(workplace* or "work place*" or "work site" or worksite or work or employee*) ti, ab, hw. AND (“eating behavio?r*” or diet or eating) ti, ab, hw.	Published date (2008-2018), English Language, peer reviewed, human participants.

Appendix 2 *Assessment criteria of the methodological quality of included studies in systematic review*

Criterion	**Rating for quantitative studies**	**Rating for qualitative studies**
Methodology (max of 6)		
Research question (RQ), aims and design	2= Clear RQ/aims that were related to relevant theoretical frameworks and an appropriate design.	2= Clear RQ/aims which is appropriate for qualitative method selected and purpose made explicit such as description/explanatory intent, theory building, hypothesis testing
	1= Clear RQ/aims with appropriate design.	1=Clear RQ/aim which is appropriate for qualitative method selected.
	0= RQ/aims are not clear and/or design is not appropriate for RQ/aims	0= RQ/aims are not clear and/or method is not appropriate for RQ/aims
Sampling Method	1=Appropriate for design	1=Appropriate for design
	0=Not appropriate	0=Not appropriate
Sample size	1= Justified and satisfactory	1= Justified and satisfactory
	0=Not justified	0=Not justified
Data collection	2=Data collected using validated measurement tools throughout	2= Justified and clearly outlined (e.g., for interview- how were they conducted? Who conducted them? Were they structured/semi

		structured/unstructured? Was a topic guide used? Were thy audio=recorded?) Triangulation of data sources if appropriate
	1=Some use of validated tools, no non-validated measurement tools, but tools are available or described.	1= Partly justified and outlined
	0= No description of the measurement tool	0= Not clear
Analysis (maximum of 3)		
Reliability of analyses	2= The study statistically controls for the most important and additional relevant confounding variables	2=Strategies to improve rigour of analyses are appropriate to outline approach (i.e., deviant case analysis, inter-rate reliability, triangulation, member checking) and analysis process is clearly documented.
	1= The study statistically controls for the most important confounding variable	1= Analysis process is clearly documented and could be replicated.
	0=No control for confounding variables	
Analysis is appropriate for RQ and aims		
	1=Statistical test used to analyse the data is suitable and clearly described, Data reported in appropriate detail for the given statistical test e.g., confidence intervals, probability level (p value)	1= Analysis is supported by sufficient data excerpts from a whole range of participants.
	0= The statistical test is not appropriate, no clearly described or incomplete.	0= Analysis is not well supported by data excerpts and/or there is an overreliance on specific participants.

Appendix 3 *Characteristics of included studies in systematic review*

Author(year) Country	Study Design	Workplace Setting	Participants	Measure/s of eating behaviours	Eating behaviour outcome	Relevant findings	Relevant conclusions	Quality score
Baskin et al (2016), USA	Cross-sectional	Google Offices, New York	N=400 (approx.)	N=1170 snack choices were observed (if employees first action had been to take drink first)	Number of observed snack choices	Employees closest to the snack station were more likely to take a snack.	Employees can decrease snacking by increasing distance between drinks and snacks.	7
Freedman et al (2010), USA	Cross -sectional	University	N=806 (71% female, 29% male)	Questionnaire- (e.g., food purchase behaviours, Self-report (F & V), physical nutrition environment, influence of friends/ family.	Multiple	Employees with overweight/obesity (48%) more influenced by food choices available in on-campus dining facilities ($p<.05$).	Workplaces need to improve access to healthy foods on campus e.g., increase awareness of healthy foods; provide nutritional information at point of purchase.	7
Haugaard et al (2016), Denmark	Longitudinal	International centre for innovation and knowledge transfer	N=71 (35 female, 36 male)	519 lunch meals over 3 months. Participants completed survey before and after lunch. Photographed food before eaten and leftovers. Weight/calories estimated from photos.	Amount of food consumed in lunch canteen meal	Ambience consisted of three elements: time available to eat lunch, lunch with close colleagues, and mindful eating.	Quality food items and improving ambience are important.	7
Hartline-Grafton et al (2010), USA	Cross- sectional	22 schools	N=329	Two 24-hour dietary recall to randomly selected participants.	EOF	On average employees consumed 2.2 of their 5.9 meals at work, accounting	Large proportion of energy consumed at work, attention should be paid to quality and quantity of food.	7

				(Eating occasion frequency) not an official measure so total EOF calculated using sum of eating occasions for each 24-hr recall (breakfast, lunch, dinner snack or other) and then averaged.		for 37% of daily energy. EOF were not associated with BMI. Of all eating occasions breakfast was mostly commonly skipped.		
Hollands et al (2018), UK	Randomised controlled trial	9 worksites (6 worksites were analysed)	N=9 worksites in England were recruited (participant number or gender not reported)	Sales data (intervention/non-intervention categories).	Total energy (kcal) purchased per day from intervention categories and non-intervention categories.	There was no statistically significant change when data from all six sites were pooled for Daily energy (kcal) purchased from intervention categories,	The results suggest that smaller portions could be effective in reducing energy purchased from targeted food categories.	6
Inoue et al (2010), Japan	Longitudinal	Large financial firm	N= 24,596 6029 male and 18,567 female)	Survey: fixed lunchtime was categorized by 4 options (fixed, occasionally not fixed, not fixed every day, do not eat lunch) (last two categories were classified as not fixed	Lunchtime habits	Sales workers may find it more difficult to take a lunch break. No fixed lunchtime (not fixed everyday/do not eat lunch) associated with increase in BMI in women.	Element of work (i.e., no fixed lunchtime) may have contributed towards higher BMI.	7

Lake et al (2016), UK	Qualitative	Local government offices	N=23 (17 female, 6 male)	Qualitative interviews with participants who had taken part in the fruit at work study.	Multiple	Relevant themes included availability of unhealthy foods high at work e.g., vending machines, food purchased at work unhealthy. Sugar intake at work high.	Access/ availability are both barriers and facilitators to encouraging healthy eating in the workplace. Managers/colleagues important	9
Lima, Costa and Rocha (2018), Portugal	Cross-sectional	Employees of the University of Porto (UP)	N=513 (65.5% female)	Food consumption habits at the workplace and 24-hour recall.	Multiple	Availability of foods	Workplace environment influences food choice, environment can be tailored	4
Park et al (2017), South Korea	Qualitative	Large corporate group (12 companies in total)	N=22 (13 male and 9 female)	Interview questions around eating behaviours throughout the working day.	Multiple	Themes included cost of healthy food, choice/availability of food, work demands.	Changing social norms might be more effective than individual interventions for eating at work.	8
Payne et al (2013), UK	Qualitative	Multinational company	N=24 (gender not specified)	Interview questions around eating behaviours throughout the working day.	Multiple	Relevant themes included; availability of unhealthy foods, workplace cultural norms, work demands.	Work generally has a negative impact on eating behaviours in the workplace.	7
Pridgeon and Whitehead (2013), UK	Qualitative	UK council	N=23 (13 female, 10 male) Volunteers	Interview questions around eating behaviours through the working day.	Multiple	Themes included cost of healthy food, choice/availability of food, work demands.	Highlights issues with provision of healthy food and healthy eating in the workplace. Findings may inform future interventions.	6

Sonnetag et al (2017), Germany	Cross-sectional	Broad range of occupational groups and industries.	N=247 (50% male, 50% female)	Online survey: measures included organisational climate, eating motives, self-control demands.	Snacking behaviours, eating motives	Self- control demands predicted affect regulation. Affect regulation predicted eating more sweets during the working day.	High self-control demands at work can increase likelihood of unhealthy eating. Health promoting eating climate at work is important.	7
Sforzo et al (2012), USA	Randomised control trial	Multinational financial investment corporation	N=96 employees. (52 females, 44 males)	Access only group (discounted meals/fitness facilities) and access + education group.	Number of times healthy meal card used in workplace canteen.	Employees voluntarily used healthy meal card only 1.5 times per week. Physical health benefits not observed.	Free choice and motivation are important in health behaviours.	7
Thorsen et al (2010), Denmark	Longitudinal	3/5 workplaces majority sedentary work. Electronic component distributor, bank and town hall.	Five Danish worksites serving from 50 to 500 meals a day. Gender not recorded	Average F&V consumption in canteen collected over 3-week period, then compared to same 5 canteens at baseline, and then at a 1 year follow up.	Average consumption of F & V per meal per day.	All three worksites increased F & V consumption from baseline to one-year follow-up and 5 year follow up (144g, 66g, 105g).	Substantiality of F & V is possible in worksites.	7
Van Epps et al (2016), USA	Experimental	Large health care organisation	N=453-enrolled on study, 249 placed at least one order Gender not recorded	Calorie content of lunch orders	Calorie content of lunch orders (compared to controls).	Ordered lunches through website, presented menus with calorie info, traffic light labels or both together. Compared lunch orders with a control condition of no calorie information.	Label reduced lunch calories by approx. 10% nutritional knowledge was not improved. No benefit or negative effects from combining label types.	8

Van Epps et al (2016), USA (Study 1)	Experimental	Corporate office setting'	N=394 Gender not recorded	Calorie content of lunch orders	Calorie content of lunch orders	Ordered lunches through website, presented menus with calorie info, traffic light labels or both together. Compared lunch orders with no calorie information. Larger delay between ordering food and consumption lead to healthier choices.	Same as above.	7
Van Epps et al (2016), USA (Study 2)	Experimental	Corporate office setting'	N=296 (placed at least one order) Gender not recorded	Calorie content of lunch orders (participants placed orders in advance (i.e., before 10:00 A.M.) or at lunchtime (i.e., after 11:00 A.M.)	Calorie content of lunch orders	Participants were more likely to select from lower calorie category when ordering in advance. Under 500-calorie meal label helped to reduce calories selected.	Participants could choose to opt in or out the experiment on a day-to-day basis- this may have introduced bias.	7
Vasiljevic al (2018), UK	Randomised control trial	6 English workplace cafeterias employees office based).	N=6 worksites (majority were office-based positions) Gender not recorded	Sales data (pre intervention and during intervention)	Total energy (kcal) purchased from intervention items in each cafeteria each day.	Only one site showed a statistically significant effect of the intervention, with an estimated 6.6% reduction (P = .044) in energy purchased in the day following the introduction of calorie labelling, an effect that	Labelling only had an effect in one canteen. A number of issues with the intervention may have caused this result.	7

						diminished over time.		
Vyth et al (2010), Netherlands	Randomised control trial (Cluster randomised control trial)	Office workers	N=13 intervention cafeterias, Food items in intervention cafeterias were assigned choices logo for period of 3 weeks. Gender not recorded	Sales data of soups and sandwiches collected over 9-week period. 1 intervention company (N=368) questionnaire	Purchases in workplace canteen (soups, sandwiches, snacks, fruits, salads) compared with control cafeterias.	No meaningful effects found on food choice.	The intervention did not have an effect on employee's lunchtime food choices.	8
Weijzen et al., (2008), Netherlands	Longitudinal	Office employees	N=585 (65% male, 35% female)	Participant's selection intentions for a snack 1 week later, they choose a snack from the same snack options.	Participants snack choice intentions vs actual snack choice	49% (n=285) of participants intended to choose a healthy snack, 27% (n=78) of this group chose an unhealthy snack instead. 92% (n=276) of unhealthy intenders went on to choose an unhealthy snack.	Discrepancy was demonstrated between intentions to consume a healthy snack and actual snack choice. A strength is that food choices were observed not self-reported.	7

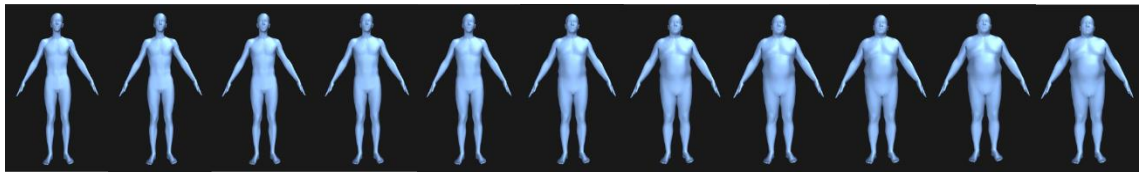
Wang et al., (2016), USA	Longitudinal	School employees	N=633 adults (65.6% females, 34.4% males)	Social support for eating 'encouraged me not to eat unhealthy food when I'm tempted to do so' social undermining 'brought me foods I am trying not to eat'.	Co-worker support for healthy eating.	Social support from colleagues for healthy eating in the workplace was associated with healthy food choices and weight loss.	Interventions to help social undermining of healthy eating of family are required.	8
Yoon et al (2011) Korea	Experimental	Electronics industry workplace	N=95 (66=office workers, 29= factory workers). (84 males, 11 females)	Pre and post intervention, eating habits assessed at work	Number of times dined with colleagues	Following intervention dining together occurrences didn't alter, as eating together is part of Korean culture.	Intervention overall decreased BMI and health status.	4
Zunker et al., (2008), USA	Qualitative	Worksite of 400 employees (majority office-based roles).	N=14 (all female participants)	'What factors of your job affect your weight?'	Multiple	Following factors all influenced unhealthy eating patterns at work: Stress at work, unhealthy food environment, social influences.	Interventions should focus on individual, social, cultural and environmental behaviours.	6

Appendix 4 *Master distribution*

Appendix 5 *Table of dimensions for male figures by waist size*

Figure number	Waist size (cm)	Weight	Height	BMI	Objective weight status
1	64	56	175	18.2	Underweight
2	68	59	175	19.2	Healthy weight
3	72	63	175	20.5	Healthy weight
4	76	67	175	21.8	Healthy weight
5	80	71	175	23.1	Healthy weight
6	84	75	175	24.4	Healthy weight
7	88	80	175	26.1	Overweight
8	92	84	175	27.4	Overweight
9	96	89	175	29	Overweight
10	100	94	175	30.6	Obese
11	104	99	175	32.3	Obese
12	108	105	175	34.2	Obese
13	112	110	175	35.9	Obese
14	116	116	175	37.8	Obese
15	120	122	175	39.8	Obese
16	124	128	175	41.7	Severely Obese
17	128	134	175	43.7	Severely Obese

Appendix 6 *Bimodal distribution*



Appendix 7 *Positively skewed distribution*

Appendix 8 *Negatively skewed distribution*

Appendix 9 *Question eliciting distribution of restrained eating in females on Instagram*

Think about **females whom you follow on your Instagram account (adults only).**

10% of **adult females you follow on Instagram** deliberately limit the amount of food they eat, to influence their shape or weight on this many days per month ____

Please select your answer from the drop-down list below.