

**APPETITIVE TRAITS AND THEIR RELATIONSHIPS TO WEIGHT AND
WEIGHT MANAGEMENT**

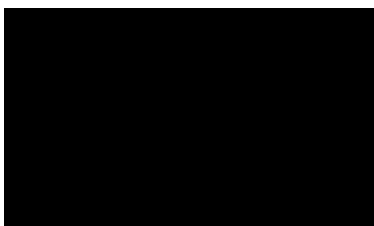
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A thesis submitted for the degree of Doctor of Philosophy

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Declaration

I, Claudia Madeleine Elizabeth Hunot, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.



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Abstract

There is a need for novel approaches to weight management (WM) for adults to address the increasing prevalence of obesity. Appetitive traits (ATs) are potentially modifiable stable predispositions towards food, which could be targeted by tailored WM interventions. Research has demonstrated associations between ATs and BMI in children, measured using the parent report 'Child Eating Behaviour Questionnaire' (CEBQ). This thesis systematically reviews the psychometric measures of ATs currently available for adults and children (Study 1). This review highlighted that the specific ATs captured by the CEBQ have not been measured in adults and so their relationships to weight remains unexplored beyond childhood. This review therefore demonstrated a need for a self-report version of the CEBQ, the 'Adult Eating Behaviour Questionnaire' (AEBQ). Study 2 describes the development of the AEBQ as a reliable measure of ATs in adults. Study 3 confirmed the AEBQ factor structure in a different sample, and showed that ATs were associated with BMI in adults. Study 4 describes the development and preliminary testing of a brief Appetitive Trait Tailored Intervention (ATTI) based on participants' AEBQ scores, to help with WM in overweight and obese adults. Study 5 involved qualitative analysis of semi-structured interviews with participants from Study 4 to provide in-depth understanding of their experiences of the ATTI. Overall, findings suggest that ATs can be measured in adults using the AEBQ, and they have similar associations with BMI to those seen in children. Using AEBQ scores to provide tailored AT feedback for WM shows promise, however refinement of the tips and delivery method is needed prior to further testing of this approach.

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Abbreviations

ASBP	The American Society of Bariatric Physicians
AEBQ	Adult Eating Behaviour Questionnaire
AIC	Akaike's Information Criteria
ATTI	Appetitive Trait Tailored Intervention
BEBQ	Baby Eating Behaviour Questionnaire
BIC	Bayesian Information Criterion
BMI	Body Mass Index
BMI-SDS	BMI standard deviation scores
BST	Behavioural Susceptibility Theory of obesity
CCK	Cholecystokinin
CEBQ	Child Eating Behaviour Questionnaire
CFA	Confirmatory Factor Analysis
CNS	Central Nervous System
CoEQ	Control of Eating Questionnaire
CFI	Comparative Fit Index
CR	Cognitive restraint
CVD	Cardiovascular disease
DEBQ	Dutch Eating Behaviour Questionnaire
D	Disinhibition
DM2	Type 2 diabetes
ecSI	ecSatter Inventory
EMAQ	Emotional Appetite Questionnaire
EE	Emotional Eating
EES	Emotional Eating Scale
EAH	Eating in the absence of hunger
EF	Enjoyment of food
EMAQ	Emotional Appetite Questionnaire
EOE	Emotional over-eating
EUE	Emotional under-eating
FF	Food fussiness
FNS	Food Neophobia Scale
FR	Food responsiveness

EPI-C	Eating Pattern Inventory for Children
FTO	Fat mass and obesity-associated gene
fMRI	Functional Magnetic Resonance Imaging
FCQ-S	State Food-Cravings Questionnaires
FCQ-T	Trait Food-Cravings Questionnaires
GWAS	Genome-wide association studies
H	Hunger
HFR	Hunger-Food responsiveness
HSS	Hunger Sensitivity Scale
IES	Intuitive Eating Scale
ICC	Intra-class correlation coefficients
KMO	Kaiser-Meyer-Olkin
MRI	Magnetic Resonance Imaging
MES	Mindful Eating Scale
MFES	Motivation for Eating Scale
NWCR	National Weight Control Registry
NFI	Normed Fixed Index
OTS	Over-eating Tension Scales
PCA	Principal Component Analysis
PEMS	Palatable Eating Motives Scale
PFS	Power of Food Scale
PET	Positron Emission Tomography
RMSEA	Root Mean Square Error of Approximation
RS	Restraint Scale
SE	Slowness in eating
SNPs	Single nucleotide polymorphisms
SR	Satiety responsiveness
SSBs	Sugar-sweetened beverages
TEDS	Twins Early Development Study
TFEQ	Three Factor Eating Questionnaire
WFQ	Weekly follow-up questionnaire
WHO	World Health Organisation

Chapter 1. Weight management

1.1 The need for weight management interventions

The worldwide problem of obesity is acknowledged as having far-reaching consequences for health and wellbeing (Kleinert & Horton, 2015). Obesity can be defined as “abnormal or excessive fat accumulation that may impair health” (WHO, 2015). Obesity is most often classified using a proxy measure of weight adjusted for height known as Body Mass Index (BMI). BMI is calculated by dividing a person’s body weight in kilograms by height in metres squared (kg/m^2). In adults, overweight is defined as a BMI between 25 and 29.9 and obesity as a BMI equal to or above 30. There are different classes of obesity defined by the extent to which an individual’s BMI is above 30 (Class I: BMI of 30 to 34.9; Class II: BMI of 35 to 39.9; and Class III: BMI of 40 and above) (WHO, 2000, 2014). Normal weight is defined as a BMI between 18.5 and 24.9, and underweight, equal to or below 18.5. BMI is widely used in obesity research, as it is simple to measure and has predictive validity for a range of health outcomes (Frühbeck et al., 2013). BMI and weight will be used interchangeably throughout this thesis.

Excess body fat is a risk factor for the development of a range of chronic diseases, such as Type 2 diabetes (DM2), cardiovascular disease (CVD) and cancer (Frühbeck et al., 2013). Obesity increases the risk of metabolic syndrome, DM2 and hypertension, which together substantially increase the risk of CVD and stroke (Brown & Kuk, 2015; Shamseddeen, Zelada Getty, Hamdallah, & Ali, 2011). Overweight and obesity carry stereotypes of laziness and a lack of self-discipline (Puhl & Heuer, 2009). This public prejudice makes obesity highly stigmatized (Wee, Davis, Huskey, Jones, & Hamel, 2013) and weight-based discrimination is common (Higgs & Thomas, 2016; Stok, Verkooijen, de Ridder, de Wit, & de Vet, 2014). Another potential consequence of obesity is low self-esteem and poor self-image, as well as disordered eating issues (Cruwys, Leverington, & Sheldon, 2015). Obesity also has great economic costs, because the health consequences place a burden on health care systems and result in losses to both productivity and disability-free life expectancy (Roberto et al., 2015).

There is seemingly no relief in sight, given the continuously rising prevalence of obesity around the globe. Between 1980 and 2013, the global proportion of overweight and obese adults increased from 28.8% to 36.9% in men and from 29.8% to 38.0% in women; the

combined increase in prevalence of overweight and obesity was 27.5% (Ng et al., 2014). In the United Kingdom (UK) in 2013, 41% of men were overweight and 26% were obese, while 33% of women were overweight and 26% were obese (Health and Social Care Information Centre, 2014). Although overweight and obese individuals frequently report both a desire to lose weight (Yaemsiri, Slining, & Agarwal, 2010) and actual attempts at losing weight (Nicklas, Huskey, Davis, & Wee, 2012; Wardle & Johnson, 2002), only approximately 20% manage to achieve significant weight loss and maintain it over the long-term (Wing & Phelan, 2005).

In summary, given the physical and psychological health consequence of obesity, it's increasing prevalence and the difficulties of weight loss, weight management has become a top priority for public health (NICE Clinical Guideline 189, 2014; The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014). Weight management refers to both the prevention of weight gain and weight loss in order to achieve and maintain a healthy weight. The ultimate aim of this thesis is to develop a novel weight management intervention for the purposes of weight loss in individuals that are already either overweight or obese.

1.2 Approaches to weight management

At a basic level, obesity results from a sustained positive energy balance (i.e. energy intake exceeding energy expenditure). However the overall picture is far more complex, and weight is known to be influenced by a range of factors, both at an environmental and individual level (Vandenbroeck, Goossens, & Clemens, 2007). A variety of options therefore exist to reduce obesity, which target some of these different causes. The majority of approaches fall into four main categories: structural which include policy approaches (such as taxation), or changes to the environment which influence active living; pharmacological strategies; surgical interventions; and lifestyle interventions and counselling (which include adherence to dietary changes and increasing physical activity through the use of behavioural strategies) (Brownell & Roberto, 2015; NICE Clinical Guideline 189, 2014). Structural approaches to obesity require a multi-level systems approach (Malik, Willett, & Hu, 2012), and address the environmental and socio-cultural factors that contribute to obesity. On the other hand, while lifestyle, pharmacological and surgical interventions may ultimately impact at a population level, they are focused more on the individual (Malik &

Hu, 2007; Malik et al., 2012), and predominantly address the behavioural factors which contribute to obesity development.

1.2.1 Structural approaches

We are currently living in an 'obesogenic' environment that promotes an overconsumption of energy and reduces total energy expenditure (Swinburn, Sacks, & Ravussin, 2009). Availability and access to convenient, inexpensive, palatable, energy-dense foods in large portions is widespread and has increased energy consumption (French, 2003; French et al., 2014; Kral, Roe, & Rolls, 2004; Piernas, Ng, & Popkin, 2013; Rolls, Roe, Kral, Meengs, & Wall, 2004). A dependency on vehicles for transport, shifts in leisure time to include greater amounts of screen time, and the move from manual labour to automation have all reduced energy expenditure (Chaput, Klingenberg, Astrup, & Sjödin, 2011; Church et al., 2011; Goodman, 2013). Various socio-economic and socio-cultural factors such as education and time constraints affect energy intake and energy expenditure, with busy families relying on fast-foods or restaurants for food consumption (Patrick & Nicklas, 2005; Vandebroek, Goossens, & Clemens, 2007). Thus, a structural approach to obesity management targets these environmental risk factors.

Applying structural approaches to manage the global obesity epidemic requires input from elected leaders, government agencies and non-governmental organisations, industry, health-care systems, schools, urban planners, agricultural and service sectors, and global institutions such as the World Bank or the WHO, which can impact on the regulations of sustained population-wide interventions and policy recommendations (Brownell & Roberto, 2015). One example of this is the implementation of the excise tax on sugar-sweetened beverages (SSBs) in Mexico in January 2014. Here, purchases of taxed beverages decreased by an average of 6% (-12mL/capita/day) and non-taxed beverages increased by 4% (36mL/capita/day) one year after tax implementation (Colchero, Popkin, Rivera, & Ng, 2016). In the UK, proposals to tax SSBs have come under considerable criticism and it has been argued that it will have minimal impact as consumption of sugary drinks only account for approximately 20% of sugar intake in UK children (Neville & Pickard, 2016).

Other environmental interventions to tackle obesity include the development of cycle lanes to promote increased physical activity and social capital (Torres, Sarmiento, Stauber, & Zarama, 2013), the inclusion of family fitness zones in urban public parks (Cohen, Marsh, Williamson, Golinelli, & McKenzie, 2012), and the structuring of urban planning codes that

impact on physical activity by increasing walking in residential environments (Christian et al., 2013). However, assessing the actual use of structural or environmental approaches to obesity management is subject to the limited evidence of the impact these changes have on a community. Results are typically available only from cross-sectional studies which lack control groups (Torres et al., 2013). Also, follow-up data tend to be collected at different times of the year, which for example, limits the interpretation of park use from one follow-up to the next (Cohen et al., 2012). Stronger evaluation of these interventions is needed to encourage the use of such approaches for the management of obesity (Christian et al., 2013; Cohen et al., 2012; Torres et al., 2013). Structural approaches to weight management are challenging as their implementation requires the cooperation of many parties, they necessitate high-level input, and have substantial financial costs (Brownell & Roberto, 2015).

1.2.2 Pharmacological interventions

Pharmacotherapy is a treatment option for weight management targeted at the individual-level. Current recommendations are that pharmacological treatment should only be considered once dietary, physical activity and behavioural approaches have been exhausted; or for those patients who cannot reach their target weight, or have reached a plateau on dietary, physical activity and behavioural modifications (NICE Clinical Guideline 189, 2014). Preferably, pharmacological treatment of obesity should be used as an adjunct to comprehensive lifestyles changes (The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014). Behavioural changes will be discussed in Section 1.2.4.

Approved obesity medications work through effects on appetite, acting as anorexigenics on satiety centres in the hypothalamic and limbic regions of the brain (e.g. sibutramine, phentermine, fluoxetine, bupropion, topiramate); or as lipase inhibitors (e.g. orlistat), reducing the absorption of dietary fat in the gastrointestinal tract (Domecq et al., 2015; Kushner, 2014). With respect to the effectiveness of pharmacological interventions, placebo-controlled trials have shown an average weight loss of approximately 2.7kg to 3.19kg with Orlistat (Kushner, 2014), the only obesity medication currently available in the UK (NHS Choices. Your health, 2016). However, there are also a number of side effects associated with the use of these drugs. In anorexigenics, these include restlessness, insomnia, dry mouth, constipation and increased heart rate; for lipase inhibitors side

effects might include steatorrhea, bloating and abdominal distension, as well as anal leakage (Kushner, 2014). The rationale for their use, as well as possible side effects should therefore be discussed between the patient and the health professional team treating the patient (Seger et al., 2013).

1.2.3 Surgical interventions

A more intensive approach to managing obesity at the individual-level is surgical treatment. Long-term outcomes of bariatric surgery are better than for lifestyle changes or lifestyle change and pharmacotherapy (Nguyen et al., 2012). Bariatric surgeries typically reduce BMI by 12 to 17 points five years post-surgery (Chang et al., 2014). The most commonly performed procedures are laparoscopic adjustable gastric banding (making up around a third of all surgeries), laparoscopic sleeve gastrectomy, and Roux-en-Y gastric bypass (comprising around half of all bariatric surgeries) (Kushner, 2014). Laparoscopic adjustable gastric banding and sleeve gastrectomy aim to induce weight loss through restricting food intake, whereas biliopancreatic diversion (gastric bypass) prevents food absorption, and techniques such as a gastric bypass provide a combination of restriction and malabsorption techniques (Seger et al., 2013). A recent meta-analysis of 164 studies, from 2003 to 2012, revealed that gastric bypass was more effective than adjustable gastric banding but was associated with more complications. Sleeve gastrectomy appears to be more effective than gastric bypass in producing weight loss, and both were more effective than adjustable gastric banding (Chang et al., 2014).

However not all patients with obesity are eligible for surgery. The American Society of Bariatric Physicians (ASBP) published an algorithm for the decision to surgically treat patients, which specified patients should only be considered if they have a BMI ≥ 30 with one or more adverse health consequences or a BMI ≥ 40 with or without adverse health consequences (Seger et al., 2013). Currently evidence is insufficient to recommend bariatric surgery for individuals with a BMI < 35 and no co-morbidities (Published by the Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014). Furthermore, many patients do not qualify for surgery, due to the risk of complications during and after surgery (Nguyen et al., 2012). Complications, occur in 10% to 17% of patients, with repeat operations in approximately 7% (Chang et al., 2014; Nguyen et al., 2012). Complications result from an altered anatomy, including malabsorption issues and the effects of dietary changes due to reduced gastric size (Kushner, 2014). These risks

should be considered for each patient, and a team of health professionals should be involved in assessing every individual case. However, for those patients that do qualify, bariatric surgery leads to weight loss and improvements in comorbidities post-surgery, attributed to changes in physiological responses to gut hormones and adipose tissue metabolism (Kushner, 2014). As with pharmacological treatments, surgery is ineffective without corresponding lifestyle changes, including dietary and physical activity modifications. Although surgery can make it easier for patients to make these modifications, patients may also require psychological interventions alongside their surgery to manage the drivers behind their eating behaviours (The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014).

1.2.4 Lifestyle interventions

Even though global efforts exist to try and make changes to the environment, and pharmacotherapy and surgery are becoming more common, the safest and less invasive approach to manage obesity is to try and change people's behaviour through lifestyle interventions (Dansinger, Gleason, Griffith, Selker, & Schaefer, 2005; Franz et al., 2007; Truby et al., 2006). Furthermore, both pharmacological and surgical approaches are only effective in combination with lifestyle change, particularly over the long term.

Lifestyle interventions include dietary advice and recommendations for increased physical activity and decreased sedentary behaviour, normally in combination with behavioural counselling to facilitate weight reduction behaviours (Göhner, Schlatterer, Frey, Berg, & Fuchs, 2012; Rapoport, Clark, & Wardle, 2000). Most guidelines recommend such programmes aim for weight losses of 5% to 10% of body weight for adults, as such losses have been associated with health improvements (Kirk, Tytus, Tsuyuki, & Sharma, 2012; National Institute of Health, 1998; NICE Clinical Guideline 189, 2014; Willett, Dietz, & Colditz, 1999). However, recent guidance suggests sustained weight losses of 3% to 5% can produce clinically meaningful health benefits and should be encouraged (Published by The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from the The Obesity Expert Panel, 2014).

An array of dietary recommendations have been used for weight loss including: low carbohydrate diets (Naude et al., 2014); reduced intake of sugars (Te Morenga, Mallard, &

Mann, 2012); reduced intake of fat (Hooper et al., 2015); higher intake of 'healthy' fat as in 'Mediterranean diets' (Nordmann et al., 2011); diets high in protein such as the 'Atkins diet'; and low carbohydrate diets which recommend the intake of high quantities of protein (Dansinger, Gleason, Griffith, Selker, & Schaefer, 2005; Gardner et al., 2007; Westerterp-Plantenga, Lemmens, & Westerterp, 2012). Weight loss can also be achieved by the explicit manipulation of the energy content of the diet, as opposed to dietary manipulation only (Kirk et al., 2012). Very-low calorie diets (VLCD) (800 kilocalories per day or less), have been found to induce greater short-term weight loss than low calorie diets (Tsai & Wadden, 2006). Commercial weight loss diets popularised by the growing slimming industry, such as Nutrisystem (a diet delivery program which includes low calorie meal replacement delivered to your door and promotes exercise and self-monitoring) have shown better short term weight outcomes than educational control or behavioural counselling (Gudzune et al., 2015). Meal replacement diets such as Slim-Fast have also had positive results in the short-term (Truby et al., 2006).

Evidence points towards structured, individualised nutritional counselling and personal support as being more important for success than the macronutrient content of the diet (Johnston et al., 2014; Kirk, Penney, McHugh, & Sharma, 2012). Although a wide range of dietary recommendations have been used for weight loss, current research has not shown convincingly that one type of diet is more successful than another. For example, in a randomised non-blinded controlled trial known as the BBC "diet trials", the effectiveness of the Atkins diet (a self-monitored low carbohydrate eating plan), Weight Watchers (an energy controlled diet with weekly group meetings), Slim-Fast plan (a meal replacement program) and Rosemary Conley (a low calorie diet with a weekly group exercise session) programs were compared in a group of adults over a six-month period. An average weight loss of 5.9 kg and an average fat loss of 4.4 kg was achieved based on an intention to treat analysis, and no diet had greater success at achieving weight loss than the other (Truby et al., 2006). A recent meta-analysis and meta-regression of 48 randomised trials of diet classes and programs similarly found that no diet was better at achieving weight change at 6 or 12 months from baseline (Johnston et al., 2014). In this review, weight loss was achieved with either low carbohydrate or low fat diets and individual differences between weight loss diets was minimal; the authors suggested that individuals should choose the diet they prefer and success is better predicted by how well individuals adhere to a diet (Johnston et al., 2014).

There is some evidence to suggest long term outcomes can be improved if diet and physical activity are combined (Johns, Hartmann-Boyce, Jebb, & Aveyard, 2014). A systematic review of eight studies which combined either diet or physical activity interventions, found these to be more effective at achieving weight loss compared to just exercise in both the short term (-5.33 kg, 95%CI -7.61 to -3.04) and the long term (-6.29 kg, 95%CI -7.33 to -5.25) (Johns et al., 2014). Although increasing physical activity in itself produces only modest weight loss, it protects against the loss of lean tissue and has significant independent benefits for cardiovascular health (The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014).

Behaviour change techniques are also important. For example, stimulus control¹ techniques (Hartmann-Boyce, Aveyard, Koshiaris, & Jebb, 2016; Wardle & Johnson, 2015; Wardle et al., 2013; Wardle, Liao, et al., 2001), self-monitoring of diet and physical activity (Burke, Wang, & Sevick, 2011; Burke, Conroy, et al., 2011), relapse prevention strategies (Strayhorn, 2002), and goal setting (Dalle Grave, Centis, Marzocchi, El Ghoch, & Marchesini, 2013; Hartmann-Boyce et al., 2016). A 2009 meta-regression of 101 studies reporting 122 evaluations of physical activity and healthy eating, found that those interventions which include self-monitoring, with any other technique derived from the “Control theory”² (Carver & Scheier, 1982), such as specific goal setting, review of goal settings, feedback of performance or intention formation, are most likely to be effective for behaviour change (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Interventions which target these as well as dietary intake and physical activity levels (as a three-component intervention) appear to be more successful compared to those interventions targeting diet and exercise either in conjunction or alone (Kirk et al., 2012). Current guidance in the UK therefore advocates this three pronged approach to lifestyle-based obesity management (NICE Clinical Guideline 189, 2014). However, although the use of such techniques can enhance

¹ Stimulus control refers to the reduction of exposure to eating cues, which helps limit the number of occasions eating can occur (Wardle & Johnson, 2015; Wardle et al., 2013).

² The “Control theory” refers to a model of self-regulation, which is presented as a feedback-loop, where a person’s perception of their current state is compared against a goal state (Carver & Scheier, 1982; Michie, West, et al., 2014).

weight loss in the short term, studies with long term outcomes suggest weight is still gradually regained once treatment stops (Wardle & Johnson, 2015), and there is still a great deal of individual variability in the success of these interventions (Stubbs et al., 2011).

1.3 Individual factors influencing the likelihood of successful weight management

Given the variation in success with weight management, a number of studies have sought to explore individual factors that might influence the likelihood of successful weight management. Reviews have found some evidence for demographic predictors of weight loss (Stubbs et al., 2011; Teixeira et al., 2010; Teixeira, Going, Sardinha, & Lohman, 2005), with age and gender consistently related to success. Men consistently tend to lose more weight than women (Stubbs et al., 2011), and women typically have higher attrition rates than men (Fabricatore et al., 2009). With respect to age, although obesity is higher among older than younger adults (Health and Social Care Information Centre, 2014), being of younger age predicts greater attrition from weight loss interventions (Fabricatore et al., 2009). However, attrition is also influenced by initial weight loss (i.e. higher initial weight loss is associated with less attrition), which is itself correlated to attendance at a weight loss program (Stubbs et al., 2011). Being older could also be beneficial, as it may bring the benefit of greater awareness of dealing with relapses and of developing stable eating and physical activity patterns. However, older age may also hinder potential weight loss due to the physiological effects of numerous previous weight loss attempts (see effects below) (Stubbs et al., 2011).

Prior weight loss attempts and participation in weight loss programs appear to predict future weight loss failure (Stubbs et al., 2011). For example, Teixeira et al. (2004) found, in 158 overweight and obese middle-aged healthy women, that a history of weight loss attempts was independently associated with non-completion in a behavioural weight management program. However, these results cannot be generalised to other ages or to men. Similarly, in the Australian Longitudinal Study of Women's Health, 79.9% of women reported using at least one weight loss strategy over the course of a year. The participants described the strategies used and the number of times they had lost on purpose more than 5kg. These strategies were categorised into four clusters; 'dieting – those who used a variety of strategies to control their weight' (39.7%), 'healthy living – eat less move more' (30.2%), 'do nothing' (20%), and 'perpetual dieters – used all strategies, including unhealthy

behaviours' (10.7%). Results showed that, despite most women trying to control their weight, they gained an average of 700g per year over the nine-year period that weight change data was assessed and the 'perpetual dieters' gained significant more weight (210g) than the 'do nothing' group ($p < 0.01$) (Madigan, Daley, Kabir, Aveyard, & Brown, 2015).

The negative impact of prior weight loss attempts on weight management success may be a consequence of the physiological changes induced by weight loss. Weight loss is associated with decreases in metabolic rate, reduced total energy expenditure greater than the weight loss achieved, and changes in hormone profile which regulate appetite (Chapter 2) (Rosenbaum, Hirsch, Gallagher, & Leibel, 2008; Sumithran & Proietto, 2013). Reductions in circulating levels of leptin³, cholecystokinin⁴, insulin⁵ and other hormones involved in appetite regulation accompany weight loss, and these changes do not appear to be transient (Sumithran & Proietto, 2013). Therefore, previous weight loss attempts can become negative weight loss predictors through diminishing total energy expenditure and metabolic rate, and a lower resting metabolic rate is associated with less weight loss (Stubbs et al., 2011). Additionally, a higher initial weight or BMI predicts greater weight loss (Stubbs et al., 2011; Teixeira et al., 2004, 2010).

On the other hand, results from an exhaustive review suggest that baseline measurements of psychosocial variables such as mood, depression and personality disorders are not predictive of treatment outcomes (Teixeira et al., 2005). Evidence for other psychological pre-treatment predictors of weight loss, such as self-esteem, body image and weight-related quality of life, have also been mixed. Authors have suggested that this might be due to measurement issues given the diversity of different assessment constructs⁶ or scales found in different questionnaires used to measure these variables (Teixeira et al., 2005). Also, the lack of associations found between these measures and weight, may be the

³ Leptin is an appetite suppressant, made in fat tissue.

⁴ Cholecystokinin is a hormone released in the gastrointestinal tract which stimulates fat and protein digestion.

⁵ Insulin is a hormone produced by the pancreas which regulates blood glucose levels.

⁶ Throughout this thesis the terms 'constructs', 'factors', 'scales', 'sub-scales' or 'dimensions' are used interchangeably to refer to the grouping of items which describe a certain type of trait, measured by a questionnaire.

results of confounding, with other factors difficult to measure (e.g. personality, upbringing), causing mixed results or none at all to be obtained (Stubbs et al., 2011).

Similar results have been observed for eating behaviour variables such as, binge eating, 'disinhibition' and 'restrained eating', which have shown very few or no associations with weight changes during treatment (Teixeira et al., 2005). Interest in measuring 'restraint' started after the proposal of the "Externality" theory (Schachter, 1968), which suggests that tendencies toward over-eating, trigger an individual's need to restrict their food intake, described as the "Restraint" theory of obesity (Herman & Polivy, 1975; Polivy, Herman, Younger, & Erskine, 1979). However, 'restraint' has also been linked with inducing counter-regulatory responses which result in binge-like or disinhibited eating patterns (Johnson et al., 2012; Stunkard & Messick, 1985), and so these variables could confound one another depending on the measures used to assess them. 'Disinhibition' is usually considered to be highly variable between individuals and associated with factors such as 'restraint' and weight gain. In general, binge eating and 'disinhibition' have been negatively associated with weight control (Polivy & Herman, 1976a, 1976b). However, although initial studies showed that 'restraint' was associated with dieting failure (Herman & Polivy, 1975; Polivy et al., 1979), later evidence has suggested that 'restraint' could be associated with better weight loss outcomes (Johnson et al., 2012). Weight loss maintenance studies have also shown that higher dietary 'restraint' scores are associated with greater weight maintenance over a 10 year period (Thomas et al., 2014). This has led to the suggestion that measures of 'restraint' may be capturing aspects of 'self-regulation' or 'self-control' (Johnson et al., 2012), factors which may promote successful weight management. Another behavioural trait which has been positively correlated to weight loss success is slow rate of eating (Stubbs et al., 2011). However, more research is needed on this and the potential for other eating behaviours to predict successful weight loss.

1.4 Tailoring weight management interventions to improve outcomes

To date there appear to be few consistent predictors of weight loss success, with the exception of prior weight loss attempts. This may reflect the fact that different individuals have varying success dependent on the programme they are following, and reviews have highlighted a need to conduct further research into individualised approaches to weight management (Stubbs et al., 2011; Teixeira et al., 2005). As previously mentioned in Section 1.2.4, results from behavioural weight loss treatments, have shown substantial individual

variability in weight loss achieved (Dansinger et al., 2005; Franz et al., 2007; Hartmann-Boyce, Johns, Jebb, Summerbell, & Aveyard, 2014; Truby et al., 2006, 2008) and there has therefore been increasing interest in the benefits of tailoring weight management treatments to an individual's biological and psychological characteristics in order to promote better weight loss (Almirall, Nahum-Shani, Sherwood, & Murphy, 2014; Celis-Morales, Lara, & Mathers, 2015). Improving understanding of the success of this type of personalised medicine could facilitate recommendations for weight management (Finer, 2015; Gardner, 2012).

A recent review and meta-analysis of 39 trials that compared self-help interventions with each other or with minimal control for weight loss in overweight and obese adults, suggested that tailoring appeared to increase weight loss when compared to non-tailored approaches (Hartmann-Boyce, Jebb, Fletcher, & Aveyard, 2015). Tailoring of diets was based on the patients' baseline information, such as personalised weight loss goals based on initial weight, height and waist circumference (WC), or on progress reports generating automated personalised feedback based on diary entries (Carter, Burley, Nykjaer, & Cade, 2013; Collins, Morgan, Hutchesson, & Callister, 2013). Tailored nutrition education based on dietary intake, food purchases and anthropometric measures have also been found to be useful at improving diets over the long term (Kirk et al., 2012; Pagoto & Appelhans, 2013). Tailoring has been used for giving personalized information on obesity risk in vignette studies (Frosch, Mello, & Lerman, 2005). Those participants assigned to an increased obesity risk vignette condition, indicated they had a greater intention of changing their behaviours than those assigned to lower risk conditions. However, overall, there are only a small number of studies to date in this area, and tailoring has been focused mainly on baseline physiological conditions, such as the presence of DM2, or cardiovascular risk factors (The Obesity Society and American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Based on a systematic review from The Obesity Expert Panel, 2014). No scientific study has explored tailoring based on an individual's eating behaviours.

A potentially novel approach to improve weight management outcomes could be using information about individuals' eating behaviours or appetitive traits⁷ to inform weight loss recommendations. Given that certain pharmacological and surgical approaches to obesity treatment involve suppressing appetitive pathways, developing behavioural strategies to help an individual manage their appetitive traits might be a less invasive way to help overweight and obese individuals to lose weight. Appetitive traits and their influence on weight will be addressed in the following Chapter 2.

1.5 Summary of the findings

Effective weight loss strategies are much needed in the prevailing global obesity landscape. The physical and psychological health consequences of obesity, as well as its increasing prevalence, mean that reducing obesity through weight management has become a priority. Different approaches to weight management have been developed, ranging from environmental and policy change to the more individual pharmacological, surgical and lifestyle approaches. There is little evidence that individual factors affect how successful any given person is at achieving weight loss, but there may be merit in matching individuals to different treatments better suited to their biological and psychological profiles. There is emerging evidence for the use of such factors to tailor weight management interventions, and tailoring based on eating behaviour phenotypes or appetitive traits could be a helpful approach. Appetitive traits and their influence on weight will therefore be discussed in greater depth in the following chapter.

⁷ Appetitive traits are a set of stable predispositions towards food (Carnell et al., 2013). The relationship that they have to weight and weight management will be explained in detail in Chapter 2.

Chapter 2. Appetitive traits and weight

2.1 Introduction

To understand how appetitive traits might be used to tailor weight management advice to individuals who are overweight or obese, it is important to first understand what appetitive traits are and how they are associated with weight. The following chapter discusses definitions of appetite and appetitive traits, how they can be measured and how they are thought to relate to weight.

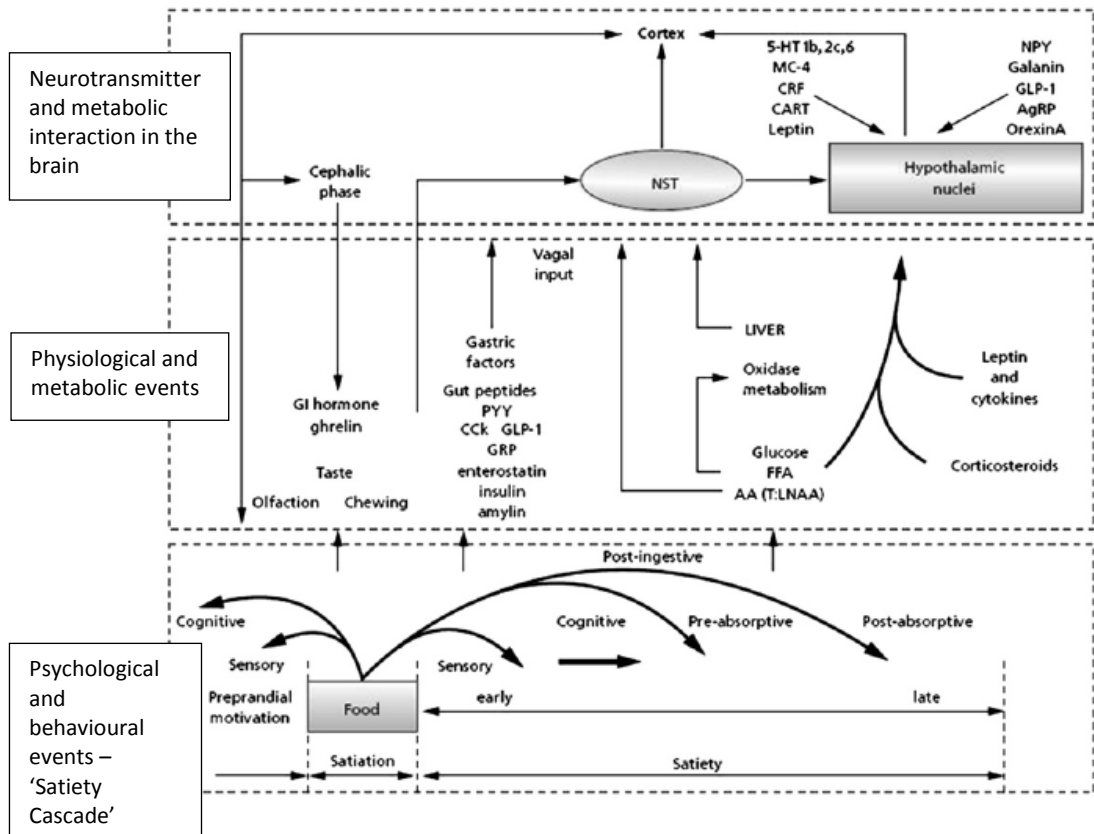
2.2 Appetite

Appetite can be defined as the process of food selection and intake, and its consumption in appropriate amounts in relation to the maintenance of body weight (Blundell et al., 2009). It is related to hunger and satiety, the psychological experiences that determine meal-by-meal eating behaviour⁸ (Blundell et al., 2009). In states of overweight, obesity, and eating disorders, appetite becomes deregulated. The expression of appetite is a complex web of biopsychological aspects, postulated to be controlled by the balance between ‘homeostatic’ and ‘hedonic’ pathways. These factors have also been posited to play a key role in an individual’s vulnerability to gain weight (Blundell et al., 2005).

The ‘homeostatic’ mechanisms are mediated by a need to maintain energy balance, for example increasing motivation to eat after depletion of energy stores. There are two types of ‘homeostatic’ signals: ‘tonic’ signals and ‘episodic’ signals. ‘Tonic’ signals, such as leptin secretion, provide a message of hunger and are involved in more stable long term energy reserves. ‘Episodic’ signals are mediated by peripheral satiety signals from the gut (e.g.

⁸ In the literature, eating behaviour is a term sometimes used to refer to appetitive traits. For the purpose of this thesis I will make a distinction between these terms. ‘Eating behaviour’ will refer to a broader spectrum of behaviours related to eating, including all the processes around the ingestion of food, such as thoughts, actions, and intents; whereas ‘appetitive traits’ will refer to stable predispositions towards food, which are thought to be susceptible to environmental interaction, potentially predisposing an individual to weight gain.

cholecystokinin secretion) and are involved in short-term energy maintenance in response to recent consumption. In contrast to these ‘homeostatic’ mechanisms, ‘hedonic’ control of appetite is related to reward-based pathways and maintains a drive to eat. There is a strong interplay between the ‘homeostatic’ and ‘hedonic’ pathways (termed the ‘satiety cascade’) (Blundell et al., 2009; Harrold, Dovey, Blundell, & Halford, 2012) (Figure 2.1).



Source: (Harrold et al., 2012)

5-HT, serotonin; AA, amino acids; AgRP, agouti-related peptide; CART, cocaine and amphetamine-regulated transcript; CCK, cholecystokinin; CRF, corticotrophin releasing factor; FFA, free fatty acids; GI, gastrointestinal; GLP-1, glucagon-like peptide-1; GRP, gastric releasing peptide; MC, melanocortin; NPY, neuropeptide Y; NST, nucleus tractus solitarius; PYY, peptide YY; T:LNAA, tryptophan large neutral amino acid ratio.

Figure 2.1 The psychobiological network of appetite regulation

The psychobiological network of appetite regulation shown in Figure 2.1 represents the different aspects of ‘homeostatic’ and ‘hedonic’ control of appetite, which will be briefly explained in the following sections.

2.2.1 The homeostatic control of appetite

‘Homeostatic’ control of appetite originates pre-prandially (prior to meal ingestion).

Hunger signals are activated by the sight and smell of food, and they signal the brain via

cranial nerves to promote food intake. The proposed interactions between the 'satiety cascade' (the physiological and metabolic events occurring during the satiation and satiety processes) and the neurotransmitter and metabolic interactions which occur at the Central Nervous System (CNS) level and control both 'episodic' and 'tonic' processes of appetite control are seen in Figure 2.1. The short-term control of food intake is an 'episodic' activity (i.e. a pattern of food episodes) that is primarily modulated by the gastrointestinal tract. These temporary oscillations in energy influx are mainly caused by periodic meal intake. The 'tonic' control of appetite responds to the depletion and repletion of energy stores, representing the longer-term control of food intake. It is controlled by glucose metabolism and fat storage in the adipose tissue, liver and pancreas via leptin, insulin and glucagon⁹. Signals are released from storage tissues when energy is depleted and these signals then stimulate energy intake. 'Tonic' signals characterise a more accurate representation of energy needs than those driven by periodic 'episodic' signals (Harrold et al., 2012).

2.2.2 The hedonic control of appetite

The 'hedonic' control of appetite is mediated by reward, maintained by the drive to eat highly palatable foods, which in turn stimulates over-consumption and maintains a system based on pleasure (mainly sensory), compared to a biological need (as in 'homeostatic' control). It relates to the feeling of pleasure arising from or associated with eating. However, it also involves other more complicated processes around the *incentive value of foods* ('liking') and the *reward value of foods* ('wanting') – and is referred to as the major driving force for food ingestion (Finlayson, King, & Blundell, 2007). Brain neurotransmitters are involved with 'hedonic' processes, including glutamate, opioids, endocannabinoid and dopamine, and they have been postulated to be involved in the 'wanting' and 'liking' control processes (Harrold et al., 2012).

2.2.3 Interplay of homeostatic and hedonic control of appetite

In the current obesogenic environment where highly palatable foods are freely available, regulating pleasure and reward from the 'hedonic' pathways can lead to a diminished

⁹ Glucagon is a pancreatic hormone which promotes glycogen breakdown for glucose formation in the liver.

control of the 'homeostatic' mechanisms, which in turn leads to hyperphagia (excessive eating) and obesity. People may become over-responsive to the pleasure of eating and homeostasis (physiological consequences of ingestion) is overridden by the 'hedonic' mechanisms. However, these systems do not operate independently; a careful balance is required to maintain energy balance and thus control of body weight (Blundell & Finlayson, 2004).

The susceptibility to overeat is extremely variable among individuals. Because of the complex nature of appetite, and the different aspects involved, a number of distinct appetitive traits have been defined to facilitate its measurement.

2.3 Appetitive traits

Appetitive traits can be defined as stable predispositions towards food (Carnell, Benson, Pryor, & Driggin, 2013). Appetitive traits fall into two broad groups: 'food approach' and 'food avoidance' traits (Viana, Sinde, & Saxton, 2008; Wardle & Gibson, 2001). 'Food approach' (or eating-onset) traits such as 'food responsiveness', 'external eating', 'disinhibition', 'emotional over-eating', 'enjoyment of food', and 'hunger' are associated with larger appetites or greater interest in food. 'Food avoidance' (or eating-offset) traits, such as: 'restraint', 'satiety responsiveness', 'emotional under-eating', 'food fussiness' and 'slowness in eating', are associated with better appetitive control and/or a lower interest in food (Table 2.1).

Table 2.1 Appetitive traits

Appetitive Traits	Traits	Description
'Food approach' – food-onset traits	'Food responsiveness'	Measures interest in food and drive to eat.
	'External eating'	Increased consumption of food due to the response to the sight and smell of food.
	'Disinhibition'	The tendency to over-eat in response to external eating and/or eating in response to negative moods.
	'Emotional over-eating'	Assesses tendencies to over-eat in negative emotional states.
	'Enjoyment of food'	Measures the level of subjective pleasure experienced from eating.
	'Hunger'	An individual's perception of their level of motivation to eat and the extent to which this elicits food intake.
'Food avoidance' – food-offset traits	'Restraint'	The tendency of some persons to restrict their food intake in order to control their body weight.
	'Satiety responsiveness'	Measures an individual's fullness threshold.
	'Emotional under-eating'	Assesses tendencies to under-eat in negative emotional states.
	'Food fussiness'	Assesses pickiness with regard to the type of food an individual is willing to eat.
	'Slowness in eating'	Evaluates the pace at which an individual consumes their food.

2.4 Measures of appetite and appetitive traits

Appetite and appetitive traits have been measured experimentally and psychometrically. Experimental measures include both standard laboratory and neurological/neuroimaging

measures, whilst psychometric measures are typically questionnaires. Neurological studies have the potential to link the 'homeostatic' and 'hedonic' neurological pathways of appetite with obesity (Carnell, Gibson, Benson, Ochner, & Geliebter, 2012). In contrast, the phenotypic expression of appetitive traits is more frequently investigated under laboratory conditions or through psychometric measures (Blundell et al., 2005).

This section reviews the main methods of measuring appetite and appetitive traits as identified in a number of key reviews and book chapters (Allison & Baskin, 2009; Blundell et al., 2009; Faith, Carnell, & Kral, 2013; French, Epstein, Jeffery, Blundell, & Wardle, 2012; Llewellyn, Carnell, & Wardle, 2011).

2.4.1 Experimental measures of appetite and appetitive traits

Experimental measures of appetite and appetitive traits can be subdivided into neurological and laboratory measures.

2.4.1.1 Neurological measures

Neurological markers of appetite capture the neural appetite response pathways by using brain activation imaging. Typically, neuroimaging studies have used positron emission tomography (PET), functional magnetic resonance imaging (fMRI) and magnetic resonance imaging (MRI) to assess appetite. In these studies, the appetite of a study participant is triggered by a food cue and the measured appetite response could represent both normal neurological responses ('homeostatic') and reward anticipation responses ('hedonic'), as well as cognitive attempts to inhibit those responses (Carnell et al., 2013).

2.4.1.2 Laboratory measures

Laboratory measures of appetite can be subdivided into those designed to measure prandial (within-meal effects or effects that occur during the eating process) such as eating speed or post-prandial (effects that occur following eating) such as satiation. These usually use a pre-load test (as the independent variable) that is strictly fixed in terms of factors such as weight, volume, energy density, macronutrient content, with only the variable under investigation allowed to vary (e.g. measuring response to food cues, where a snack is presented 15 minutes after the consumption of a standardised meal). Satiety can be measured using time until the next eating episode and by the characteristics of food consumed under strict fixed conditions (weight, energy density, etc.) (Blundell et al., 2009). Examples of some of these measures for certain appetitive traits are given below.

'Food responsiveness', 'external eating' and 'enjoyment of food'

Experimental studies of the sensory activation of eating (Jansen et al., 2003) expose participants to sensory food cues (intense smell of tasty food) versus no food cues (control task, such as an activity) and measure the amount consumed of a particular food after exposure (Jansen et al., 2003). These experiments test participants' response to external food cues (i.e. 'food responsiveness', 'external eating', and 'enjoyment of food'), and measure participants' capacity to down-regulate their appetite after food consumption (i.e. 'satiety responsiveness') (Carnell & Wardle, 2008b).

In children, 'external eating' behaviour, or eating in the absence of hunger (EAH) (Birch, Fisher, & Davison, 2003; Fisher & Birch, 1999), has also been studied, by measuring a tendency to over-eat palatable food ('food responsiveness' and 'enjoyment of food'). The laboratory setting uses a 'free-access procedure', where access to low nutrient and high energy density foods (such as pretzels, chocolate, or popcorn), presented as snacks, 15 minutes after the consumption of a standardised meal and the child feels full and no longer hungry (Fisher & Birch, 2002).

The value of food has also been studied in the laboratory through exploring in what circumstances children choose palatable food over food with lower palatability or over other enjoyable activities (Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008). This model of appetite measurement assesses how much a participant is willing to 'work' to access food of higher versus lower palatability, or for a food reward versus a non-food reward (such as a video game), thus measuring the motivational drive to eat for pleasure or reward. Progressive schedules of reinforcement are set up to measure the amount of work a person is willing to do to obtain a food reward (Lappalainen & Epstein, 1990). The 'reinforcing value of food' is dictated by the time it takes for a person to choose a non-food reward versus a palatable food, which acts as a measure of responsiveness to external food cues (i.e. 'food responsiveness' and 'external eating').

Other laboratory methods for exploring 'food responsiveness' and 'enjoyment of food' include food preference studies (i.e. the extent to which an individual likes certain foods)

(Birch, 1998). These studies often use *taste tests*¹⁰ whereby participants sample a range of foods and rank their preferences among the tested foods (Blundell & Cooling, 1999; Halford et al., 2008). Preferences for highly palatable foods suggest someone is motivated by ‘hedonic’ pathways which are transmitted by reward circuits that over-ride ‘homeostatic’ pathways. This represents an interaction between ‘liking’ of food linked to affect and incentive, versus a more motivational ‘wanting’ component (Blundell et al., 2009; Finlayson et al., 2007).

‘Satiety responsiveness’ and ‘slowness in eating’

Laboratory measures of caloric compensation assess the ability of a participant to adjust food intake according to the energy level of a pre-load. The compensation can be quantified in both adults and children by comparing the amount of an ad libitum meal eaten a short time after a pre-load, which can be higher or lower in energy (Carnell & Wardle, 2007b; Johnson & Birch, 1994; Mattes, Pierce, & Friedman, 1988). These measures test the idea that an individual who is responsive to internal satiety cues (i.e. has high ‘satiety responsiveness’) is able to compensate their food intake according to the energy content of the pre-load given before a meal. Those individuals who are not sensitive to their internal satiety cues will not compensate (Carnell & Wardle, 2007). A short-term energy-compensation procedure (COMPX score) is given to indicate how much a meal is compensated for after pre-load ingestion (Johnson & Birch, 1994).

Microstructural analysis of ingestive patterns is a method used to measure eating rate and the trajectory or stages of eating, breaking it up into smaller structures, such as quantity of food per unit of time per meal (Guss & Kissileff, 2000). A slowing down of eating rate, demonstrated by a decelerating cumulative intake curve is associated with a ‘normal’ pattern of satiety in adults, while non-deceleration is associated with low ‘satiety responsiveness’ (Meyer & Pudal, 1972). Eating rates are thought to signify one’s level of hunger and motivation to eat. ‘Slowness in eating’ is operationalised as the total amount of energy consumed (calories or mouthfuls) within a given time and is measured as kcal/min

¹⁰ Taste-tests are more specific measures of ‘liking’ (i.e. the incentive values of food) (Finlayson et al., 2007).

or bites/min. A faster eating rate has been associated with a greater intake of food (Kaplan, 1980).

'Food fussiness'

'Food fussiness' or picky eating is a tendency to be extremely selective about foods (Taylor, Wernimont, Northstone, & Emmett, 2015). It refers to both the rejection of unfamiliar foods (neophobia), as well as known or familiar foods. Picky eating behaviour in both adults and children has been measured in laboratory settings using food selection situations (Pliner & Hobden, 1992). Taste tests can also be used as a proxy measure of fussiness, with participants who report liking fewer foods or a narrow range of foods rated as more 'picky' (Blundell & Cooling, 1999; Halford et al., 2008).

'Restraint' and 'disinhibition'

'Restraint' is measured under laboratory conditions by observing whether individuals consciously attempt to control their energy intake, by restricting food intake in response to a high calorie pre-load (Herman & Polivy, 1975; Polivy et al., 1979). Increased food intake described as counter-regulation¹¹ or 'disinhibition' (Johnson et al., 2012; Stunkard & Messick, 1985) (Section 1.3, Chapter 2), has been observed in response to dysphoric mood (Herman & Polivy, 1975) and alcohol ingestion (Polivy & Herman, 1976b). Restrained eaters who are induced to break their 'restraint' with a high calorie pre-load and then asked to eat unlimited palatable food have shown counter-regulation (Wardle & Beales, 1988), but these behaviours cannot be extrapolated to real world situations (Johnson et al., 2012).

2.4.1.3 Limitations of experimental measures

Experimental measures of appetite have the advantage of being objective measures of eating behaviour under different conditions and are used to accurately measure particular aspects of food response such as taste or preference. However, they have limitations, and

¹¹ From the "Restraint" theory, counter-regulation refers to control over eating being undermined, which results from trying to control eating cognitively (Herman & Mack, 1975; Herman & Polivy, 1975).

concerns have been expressed about their validity¹² (i.e. whether they are actually capturing the aspect of appetite which they intend to measure), reliability and whether the findings are reproducible (Carnell & Wardle, 2007). For example, it is difficult to control the entire diet for a group of individuals over a prolonged period of time and therefore laboratory measures of appetite primarily focus on one mealtime without assessing food intake throughout the day (Carnell & Wardle, 2007). In the case of neurological measures, it is difficult to expose participants to different food cues (e.g. visual and olfactory) simultaneously in order to track the neurological response of one particular system (Carnell et al., 2013), and these studies can be difficult and inconvenient to run. Experimental studies, which assess a particular meal condition are more viable, but they have significant limitations in their application to human obesity, as behaviour is only captured on one occasion in an artificial context; therefore they cannot claim to be true measures of traits (Carnell & Wardle, 2008b). Furthermore, given that conditions have to be very strict for reproducibility, experimental studies do not resemble everyday life (Blundell et al., 2009). Experimental studies of appetite can be expensive as they require special laboratory settings, and are typically only possible in small samples, providing potential challenges for statistical power and external generalisability (Carnell et al., 2013; Carnell & Wardle, 2007). However, experimental measures are used to validate specific aspects of appetite captured by psychometric assessment, and together both types of measures strengthen each other.

2.4.2 Psychometric measures of appetite and appetitive traits

The use of validated and reliable questionnaires to measure appetitive traits removes the costly obstacles of laboratory and neurological measurements. Psychometric measures are standardised quantitative questionnaires concerned with the study of psychological dimensions. They are convenient to administer to large numbers of participants and are beneficial for statistical power and may better reflect 'real-world' conditions (Streiner & Norman, 2015). They can also be used to incorporate behaviours over many different

¹² Different types of validity can be measured, mainly content validity which examines the content of the items; criterion validity that measures how well the scores on a test agree with the performance on a task it was meant to predict; and construct validity which refers to the nomologies embedded in the scale (i.e. the meaning of the construct/trait being measured) and it can be either convergent or discriminant (Streiner & Norman, 2015).

situations (e.g. 'Do you eat more when you: smell food/ see others eating'). These in turn may be used to reveal untapped behavioural 'traits' which are more stable or 'tonic' in nature (Carnell & Wardle, 2007), as opposed to 'states'¹³ related to periodic measurements of appetite that tend to fluctuate (Blundell et al., 2009; Harrold et al., 2012).

An array of psychometric questionnaires have been used to demonstrate that different aspects of appetite are associated with: parental feeding practices, composition of dietary intake, food preferences, and dietary patterns (Birch & Fisher, 1998; Birch et al., 2001; Deglaire et al., 2012; Emmett, Jones, & Northstone, 2015). Psychometrically measured aspects of appetite have also been linked with socio-environmental factors such as frequency of family meals, healthy and unhealthy food availability, and parental or peer group support (Cutler, Flood, Hannan, & Neumark-Sztainer, 2011); attempts to control weight (Schembre, Greene, & Melanson, 2009; Tapper & Pothos, 2010); or pathological aspects of appetite which include eating disorders in adults measured with the 'Eating Attitude Test' (Garner & Garfinkel, 1979), disordered eating patterns in adolescents and young adults (Larson, Neumark-Sztainer, & Story, 2009), and body image disturbances (Kroon Van Diest & Tylka, 2010).

Some of the most commonly used tools for measuring appetite, include the 'Three Factor Eating Questionnaire' (TFEQ) (Stunkard & Messick, 1985) the 'Dutch Eating Behaviour Questionnaire' (DEBQ) (van Strein, Frijters, Bergers, & Defares, 1986), and in children the 'Child Eating Behaviour Questionnaire'. The original TFEQ measures 'restraint', 'disinhibition' and 'hunger' in a 51-item questionnaire. The TFEQ has been revised into an 18 item TFEQ-R18, which measures 'uncontrolled eating' which includes 'disinhibition' and 'hunger' items from the original TFEQ, 'cognitive restraint' and 'emotional eating' (Karlsson, Persson, Sjöström, & Sullivan, 2000). The DEBQ is a 33-item questionnaire that measures

¹³ Behavioural acts of eating and food selection are also accompanied by subjective states, so a person experiencing strong hunger sensations may eat faster, quicker and more food than a person who is not as hungry. Psychological aspects of eating motivation, however, allow the theoretical distinction between different 'states' and 'traits' in order to study and measure appetite. 'States' are related to periodic sensation of hunger, fullness and 'wanting' (the drive to eat), which occur episodically, tend to fluctuate and are part of our eating patterns. 'Traits', on the other hand, are more stable across time and situations and can be identified using psychometric questionnaires (Blundell et al., 2009; Harrold et al., 2012).

'external eating', 'restraint' and 'emotional eating' in adults, as well as through parent report (DEBQ-P) (Braet & van Strein, 1997) and through self-report (DEBQ-C) in children (van Strein & Oosterveld, 2008). The CEBQ is a 35-item questionnaire, measuring eight appetitive traits; 'food responsiveness', 'emotional over-eating', 'enjoyment of food', 'desire to drink', 'satiety responsiveness', 'emotional under-eating', 'food fussiness', and 'slowness in eating' (Wardle, Guthrie, et al., 2001). The CEBQ is a parent-report measure for 3-13 year old children that has also been adapted to measure similar traits in infants using the 'Baby Eating Behaviour Questionnaire' (BEBQ) (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2011).

However, there is a need to systematically review all available measures of appetite and appetitive traits. This is therefore the aim of Study 1 in Chapter 4 of this thesis.

2.4.2.1 Limitations of psychometric studies

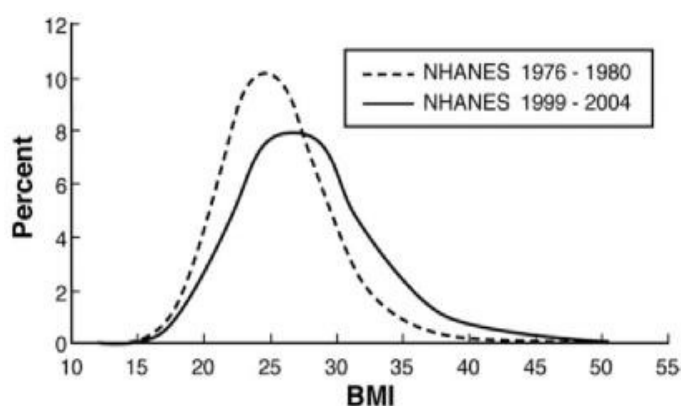
Psychometric measures are not objective measures of appetite, but they have the potential to reflect behaviour over a wide range of situations. Questionnaires lack detail about the complexity of their subject, as the individual is not able to express fully how he/she feels about his/her appetite (Oppenheim, 2003). Because self-report questionnaires about behaviours are subjective, their reliability and validity should be tested and the potential for self-report errors should also be taken into account (Streiner & Norman, 2015). One of the most common problems with psychometric questionnaires is related to response set issues, where a participant's responses to questions are based on reasons other than those intended by the researcher. For example; excessive positive or negative checking of statements (acquiescence); a tendency to answer the extremes of the response format on the questionnaire (extreme response set); and social desirability (as a tendency to choose items in terms of the perceived desirability to others, rather than those reflecting the person's actual feelings or behaviour); are all problems of response set common to psychometric measures (Allison & Baskin, 2009).

2.5 Appetitive traits and weight

2.5.1 The genetics of obesity

Obese individuals show the greatest vulnerability to weight gain caused by the obesogenic environment (Ogden, Yanovski, Carroll, & Flegal, 2007). This concentration of weight gain among the top end of the BMI spectrum, has been proposed to demonstrate a gene-

environment interaction in the development of obesity (i.e. that environmental susceptibility may be genetically determined) (Carnell, Haworth, Plomin, & Wardle, 2008; Llewellyn & Wardle, 2015; Wardle et al., 2008).



Source: (Ogden, Yanovski, Carroll, & Flegal, 2007)

Figure 2.2 Change in the distribution of BMI between 1976–1980 and 1999–2004, for adults aged 20-74 years in the United States of America (USA)

There is considerable evidence for a genetic influence on obesity (O’Rahilly & Farooqi, 2008). The tendency for obesity to run in families has been demonstrated through family studies, where obese parents were found to have a 40% chance of having an obese child; two obese parents have double that possibility (Stunkard, Harris, Pedersen, & McClearn, 1990). Twin and adoption studies have provided the most useful evidence for the heritability of weight so far, distinguishing between genetic and shared environmental effects on body weight (Llewellyn & Wardle, 2015). A review of adoption studies showed that children’s weight status was associated with that of their biological parents, but that there was no association between the weight statuses of adopted children and their adoptive parents (Grilo & Pogue-Geile, 1991), indicating a genetic basis for weight. Additionally, twin studies have shown that monozygotic (i.e. identical) twins, who share 100% of their genes, have more similar BMI and WC measurements than dizygotic (i.e. non-identical) twins, who on average share 50% of their genes (Clark, 1956). Thus, variation in BMI has been attributed to genetic differences (Stunkard et al., 1990) and estimates of BMI heritability are around 70% in adults (Maes, Neale, & Eaves, 1997; Schousboe et al., 2003; Silventoinen, Rokholm, Kaprio, & Sørensen, 2010).

2.5.2 The “Behavioural Susceptibility Theory” of obesity

The “Behavioural Susceptibility Theory” (BST) of obesity posits that environmental and genetic factors interact to promote weight gain (Carnell & Wardle, 2008a; Llewellyn & Wardle, 2015). This model postulates that the genetic risk of obesity is expressed in terms of appetitive traits which are genetically determined, and which are associated to different eating behaviour phenotypes, across the weight spectrum (Croker, Cooke, & Wardle, 2011). At an individual level, and under the appropriate environmental circumstances, the presence of adverse appetitive traits could lead to a positive energy balance and possible weight gain. The BST of obesity is depicted below Figure 2.3.

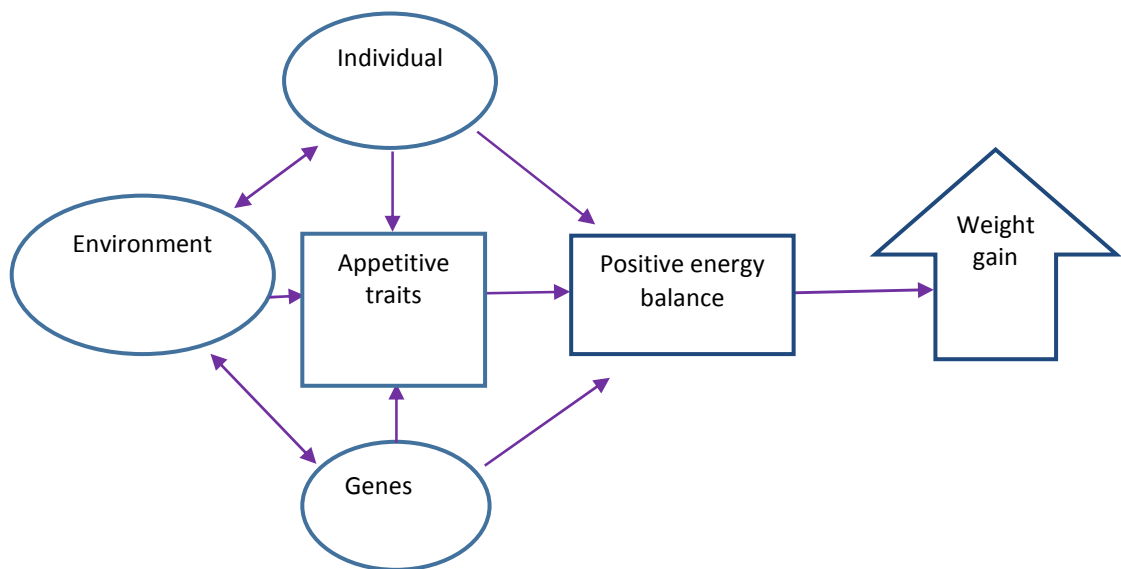


Figure 2.3 Relationships of appetitive traits to the genetically determined susceptibility of the environment

2.5.3 Evidence for the “Behavioural Susceptibility Theory”

The appetitive traits posited by the BST to play a role in an individual’s susceptibility to obesity, are those measured by the CEBQ. As such, evidence for the BST to date has been mostly provided through studies in children (Carnell & Wardle, 2008a; Croker et al., 2011; Sleddens, Kremers, & Thijs, 2008; Spence, Carson, Casey, & Boule, 2011; Viana et al., 2008), and infants (Llewellyn, van Jaarsveld, et al., 2011; Llewellyn & Wardle, 2015; van Jaarsveld, Llewellyn, Johnson, & Wardle, 2011) using the CEBQ and BEBQ respectively.

These traits have been shown to be heritable both in children (Carnell et al., 2008), and in infants (Llewellyn, van Jaarsveld, Plomin, Fisher, & Wardle, 2012). In a study of 2402 infant

twin pairs, the heritability of 'slowness in eating' and 'satiety responsiveness' traits was large, at 84% and 72%, respectively, and heritability was moderate for 'food responsiveness' and 'enjoyment of food', at 59% and 53%, respectively (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2010). Similarly, in a sample of twin pairs aged 8 to 11 years, 'food responsiveness' and 'satiety responsiveness' were estimated to have heritable components, at 75% and 63%, respectively (Carnell et al., 2008). These findings suggest that genes play an important role in the regulation of appetite in an environment which is rich with food (Piernas, Ng, & Popkin, 2013) from an early age, and may continue to regulate these traits over the life course (Llewellyn et al., 2010).

Furthermore, a number of studies have demonstrated an association between these traits and weight. In observational studies, 'food responsiveness' and 'enjoyment of food' have consistently been found to positively correlate with BMI-SDS¹⁴ in children (Carnell & Wardle, 2008a; Fuemmeler, Lovelady, Zucker, & Ostbye, 2013; Mackenbach et al., 2012; Rodenburg, Kremers, Oenema, & van de Mheen, 2012; Santos et al., 2011; Sleddens et al., 2008; Soussignan, Schaal, Boulanger, Gaillet, & Jiang, 2012; Svensson et al., 2011; Viana et al., 2008; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009). In a comparison of a community sample and a clinical sample of children referred to a hospital obesity programme, 'food responsiveness' was highest in the clinical sample, although this was not observed for 'enjoyment of food' (Croker et al., 2011). The observed differences could have been due to a lack of power given the small sample size of the clinical vs. the community sample (n=66 vs. n=406). These differences were not observed in a study in Portugal where 240 children aged three to 13 years of age were drawn from both community and clinical settings (Viana et al., 2008), although the authors failed to state the proportion of participants taken from each setting.

Studies using the CEBQ have also consistently found negative associations between BMI-SDS and 'satiety responsiveness' (Fuemmeler et al., 2013; Mackenbach et al., 2012; Rodenburg et al., 2012; Santos et al., 2011; Sleddens et al., 2008; Soussignan et al., 2012;

¹⁴ BMI standard deviation scores (BMI-SDS) are measures of relative weight in children and adolescents that are gender and age independent. They are calculated from BMI values by adjusting for age and gender using British 1990 reference data (Freeman et al., 1995).

Svensson et al., 2011; Viana et al., 2008). In Croker et al.'s study described above, 'satiety responsiveness' was lower in a clinical sample of obese children attending a weight management programme than obese children from a community sample, suggesting that those children with greater obesity are less able to feel internal satiety cues (Croker et al., 2011). 'Slowness in eating', also measured using the CEBQ, has also been shown to be negatively associated with weight in a number of studies (Croker et al., 2011; Mallan et al., 2013; Parkinson, Drewett, Le Couteur, & Adamson, 2010; Santos et al., 2011; Sleddens et al., 2008; Soussignan et al., 2012; Sparks & Radnitz, 2012; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009).

Another trait measured using the CEBQ, 'emotional over-eating', has consistently been reported to positively associate with BMI-SDS in children (Mallan et al., 2013; Rodenburg et al., 2012; Soussignan et al., 2012; Sparks & Radnitz, 2012; Svensson et al., 2011). However, associations between 'emotional under-eating' and weight have been somewhat inconsistent. Most studies have found negative correlations in children (Mallan, Nambiar, Magarey, & Daniels, 2014; Rodenburg et al., 2012; Svensson et al., 2011). Clinical groups also scored lower for 'emotional under-eating' than community groups (Croker et al., 2011). However, other studies have reported no relationship between 'emotional under-eating' and weight (Hill, Saxton, Webber, Blundell, & Wardle, 2009; Loh, Moy, Zaharan, & Mohamed, 2013; Mackenbach et al., 2012; Parkinson et al., 2010; Sparks & Radnitz, 2012; Spence et al., 2011). The studies reporting no association included one using a self-report version of the CEBQ developed for 13 year old adolescents (Loh et al., 2013); a study using a longitudinal birth cohort of maternal responses to the CEBQ at six weeks, 12 months and five to six year old infants and children (Parkinson et al., 2010); and studies from diverse socio-economic groups where confirmatory factor analysis revealed a different structure for the CEBQ compared to the original (Loh et al., 2013; Sparks & Radnitz, 2012).

Fussy eating or pickiness has been associated with failure to thrive (Wright & Birks, 2000), although these findings have been somewhat inconsistent (Carruth & Skinner, 2000), and it has also been suggested to confer protection against weight gain (Llewellyn, Carnell, et al., 2011; Wardle, Guthrie, Sanderson, & Rapoport, 2001). 'Food fussiness' measured using the CEBQ has similarly shown inconsistent relationships with weight. Some studies have found no relationship between 'food fussiness' and weight (Santos et al., 2011; Svensson et al., 2011), whereas others have reported negative associations with weight (Hill et al., 2009; Loh et al., 2013; Mallan et al., 2013; Rodenburg et al., 2012; Spence et al., 2011; Viana et

al., 2008). In the previously mentioned study comparing a community sample and a clinical sample referred to a hospital obesity programme, the clinical group scored higher for 'food fussiness' than the community group (Croker et al, 2011). The authors suggested that clinical studies tend to select samples of children with greater feeding difficulties, which could have been over-represented in this sample.

Lastly, evidence for these appetitive traits mediating the relationship between genes and BMI has recently been provided through a study from the Twins Early Development Study (TEDS) in 2258 unrelated, ten-year-old children. Polygenic obesity scores comprising 28 known obesity-related variants were associated with 'satiety responsiveness' assessed using the CEBQ. This study showed that whilst BMI-SDS and WC increased with an increase in the genetic risk of obesity, 'satiety responsiveness' decreased (Llewellyn, Trzaskowski, van Jaarsveld, Plomin, & Wardle, 2014).

Some evidence relating appetitive traits to weight in adulthood has come from other measures, mainly the TFEQ and the DEBQ. 'External eating', measured using the DEBQ, has been positively associated with weight in a number of studies in adults (Koenders & van Strien, 2011; van Strien et al., 1986). Conversely in a study of adolescents, Wardle et al. in 1992 showed 'external eating' was highest among the lowest BMI groups. In this study, 'external eating' was lower in those who perceived themselves as being fatter and also for those who were more 'restrained'. 'Emotional eating' assessed by the DEBQ is generally associated with increased weight in adults in clinical settings (van Strein et al., 1986; Wardle, 1987a). Similarly, when 'emotional eating' was measured in children using the parent version of the DEBQ (DEBQ-P), it was higher in obese vs. non-obese children drawn from clinical samples (Braet & van Strein, 1997). Although others did not find these associations in adolescents (Wardle et al., 1992). Using the DEBQ to measure 'restraint', obese adult participants had significantly higher scores on the 'restraint' scale than normal weight subjects (van Strein et al., 1986). In children, BMI-SDS also correlated positively with DEBQ-C 'restraint' but only in the normal weight groups (van Strein & Oosterveld, 2008). In pre-adolescents, using the parental report version of the DEBQ, obese and overweight subjects had higher values of 'restraint' than the normal-weight pre-adolescents (Caccialanza et al., 2004). However, in general, the DEBQ has primarily been used in the context of disordered eating behaviours (Johnson & Wardle, 2005; van Strein et al., 1986; Wardle, 1987a), compared to the evidence provided for the BST of obesity which

shows a relationships between appetitive traits and weight across the weight spectrum (Croker et al., 2011; Llewellyn & Wardle, 2015).

The TFEQ also measures a form of 'emotional eating' through its 'disinhibition' sub-scale. The 'disinhibition' sub-scale is comprised of two aspects involving weight fluctuation, as well as 'emotional eating' and 'external eating' (Arnouk et al., 1995; Stunkard & Messick, 1985). Higher positive 'disinhibition' scores have been associated with higher energy intake and higher BMI (Stunkard & Messick, 1985). Further analyses of the TFEQ have failed to replicate the factor structure of the original 51-items, and have led to the loading of items onto an 'emotional eating' sub-scale to produce two revised (shortened) versions of the TFEQ, the TFEQ-R18 and the TFEQ-R21 (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Karlsson, Persson, Sjöström, & Sullivan, 2000). Positive associations between 'cognitive restraint' and weight have been found in normal weight, but not overweight subjects when using the TFEQ-R18 (de Lauzon-Guillain et al., 2006). Similar associations were also found using the TFEQ-R18, where higher BMI was associated with higher levels of 'cognitive restraint' and 'emotional eating', but not with 'uncontrolled eating' (Anglé et al., 2009). TFEQ-R21 'cognitive restraint' and BMI correlations have been found to be significant in clinical samples (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009). However, negative associations have also been reported using the TFEQ, where lower 'cognitive restraint' and higher 'disinhibition' scores were associated with higher BMI (Williamson et al., 1995). Differences in the associations between weight and 'restraint' appear to vary according to the weight status of the samples being studied; positive associations have been observed in individuals of normal weight (Williamson et al., 1995), whereas in obese populations, negative associations have been reported (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009). It has therefore been suggested that 'restraint' might help to diminish the adverse effects of appetitive traits on weight gain in obese populations (Johnson et al., 2012).

The TFEQ also measures 'hunger', as a measure which relates to an individual's perception of their level of motivation to eat and the extent to which this elicits food intake (Stunkard & Messick, 1985). 'Hunger' (and 'disinhibition') when combined with an increase in 'restraint' were associated with weight loss parameters in 58 overweight and obese participants who completed a 12-weeks exercise supervised program (Bryant, Caudwell, Hopkins, King, & Blundell, 2012). However this could be due to confounding effects of 'disinhibition', and it has been suggested that people who usually feel hungry could also

present other eating behaviours such as cravings and disordered eating (Elfhag & Rössner, 2005). In a study of Finnish adolescent women aged 17 to 20 years, 'cognitive restraint' and 'emotional eating' measured using the TFEQ-R18 showed positive associations with BMI, but no associations were seen for 'uncontrolled eating' (which includes 'hunger' items) (Anglé et al., 2009). Again, it is unclear whether the relationship between 'hunger' and weight is being confounded by 'disinhibition'. Also problematic is the measurement of 'hunger' itself as it is subject to great variability dependent on how it is measured and also the timing of the measurement (Wardle, 1987b).

2.6 Summary of the findings

Appetitive traits are stable predispositions towards food, which make individuals more or less susceptible to certain environmental exposures that can contribute to the development of obesity. Given the complex processes involved in 'homeostatic' and 'hedonic' regulation of appetite, measurement of appetite and appetitive traits has included both experimental and psychometric assessments. Experimental measures, which include both neurological and laboratory-based measures, objectively assess different aspects of appetite under very specific conditions, limiting their generalisability to natural eating conditions. Psychometric measures of appetite, which measure different dimensions of appetite, have endeavoured to address some of the limitations of experimental measures and are useful for obtaining data from large populations in real-world settings.

The "Behavioural Susceptibility Theory" (BST) of obesity proposes that individual differences in weight are due to variation in appetitive traits. However, thus far the evidence for the BST has primarily come from studies in children and there is a lack of empirical research regarding many of the traits captured by the CEBQ in adults. Such studies would provide the evidence needed to demonstrate if the relationship between appetitive traits and weight still holds into adulthood, and if this could inform the development of tailored interventions to help individuals manage these traits and in turn their weight. The lack of such studies may be because there is no adult measure of the appetitive traits captured by the CEBQ. However, it is possible that other existing measures may capture similar traits and so a systematic review of existing measures for different age groups and the traits they capture is warranted.

Chapter 3. Aims of the thesis

Chapters 1 and 2 describe the need for weight management interventions and how a person's appetitive traits interact with the current obesogenic environment to determine their individual susceptibility to overweight or obesity. Identifying an individual's specific pattern of appetitive traits could potentially enable personalised and targeted feedback for weight management interventions.

Evidence supporting the association between appetitive traits and weight comes primarily from paediatric studies (Llewellyn & Wardle, 2015). The majority of this research has measured appetite in children using the CEBQ or the infant version, the BEBQ (Llewellyn, van Jaarsveld, et al., 2011; Wardle, Guthrie, et al., 2001). However, it is unclear whether these relationships hold into adulthood, and whether existing psychometric measures of appetite can adequately assess these traits in adult populations. A systematic review of existing measures is necessary to explore the justification for the development of a new measure of appetitive traits for use in adults. A standardised psychometric measure of appetitive traits during adulthood, measuring traits comparable to those measured by the CEBQ, would allow large-scale studies to establish relationships with BMI at different stages of the life course. Furthermore, if associations between specific dimensions of adult appetite and BMI were established, this information could be used to tailor individualised weight management advice to overweight and obese adults as part of a behaviour change intervention.

This thesis aims to address the following research questions:

1. What psychometric measures of appetitive traits currently exist?
2. Can the parent report 'Child Eating Behaviour Questionnaire' (CEBQ) be adapted into a valid and reliable measure of appetitive traits in adults?
3. How do appetitive traits relate to BMI in adults?
4. Can a weight management intervention tailored to an individual's appetitive traits be developed that is acceptable and potentially useful?

The studies in Chapters 4 to 8 attempt to address the above questions. Study 1 will explore psychometric measures of appetite previously used in adults and children through a systematic review. Study 2 describes the adaptation of the CEBQ - a parent report

questionnaire - into a self-report 'Adult Eating Behaviour Questionnaire' (AEBQ), and an exploration of its factor structure in a sample of adults aged 18+ years old (Sample 1). Study 3 aims to validate the AEBQ through confirmatory factor analysis (CFA) in a different sample of adults (Sample 2), and to establish the internal and test-retest reliability of the scales. Associations between appetitive traits and BMI will also be established. Study 4 will develop and test a brief intervention, tailoring weight management tips to overweight and obese individuals, based on their individual appetitive trait profile from AEBQ scores. Finally, Study 5 aims to assess participants' experiences of participating in this intervention through qualitative interviews.

3.1 My contributions to the research in this thesis

I played a key role in developing the aims of this thesis and the design of the studies in conjunction with my supervisors Professor Jane Wardle (who sadly passed away in October 2015, shortly after I had completed my final study), Dr Rebecca Beeken (my primary supervisor) (RJB), Dr Alison Fildes (AF), Dr Helen Croker (HC), and Dr Fiona Johnson (FJ). I performed all of the statistical analysis and interpreted the results with the help of my supervisors.

I carried out the systematic review in Study 1 with help from UCL Librarians to obtain adequate search terms. I selected the appetite measures according to the eligibility criteria, discussed previously with Dr Beeken and Dr Croker. Final study selection was also reviewed with the help of Dr Fildes and the rest of my supervisors.

For Study 2, I applied for and obtained ethical approval and was involved in all stages of the development of the AEBQ, including the translation of the items, piloting of the preliminary questionnaires and coordinated the data collection with the research sampling company. I also processed and cleaned all the data (Sample 1) and conducted the Principal Component Analysis (PCA), with additional statistical support provided by Dr Clare Llewellyn. I carried out the iteration processes, and final AEBQ item selection was agreed in collaboration with Professor Wardle, Dr Beeken and Dr Croker.

For Study 3 (Sample 2), data collection was conducted by myself and a fellow PhD student Nathalie Kliemann, coordinating with the same research sampling company used in Study 2 (Sample 1). Ms. Kliemann and I jointly achieved ethical approval for this research. I carried out the Confirmatory Factor Analysis (CFA) (Study 3) with the help of statistician, Tao Ding.

However, I ran the analysis myself using SPSS AMOS and interpreted the results with minimal statistical assistance. I independently conducted the remaining statistical analyses for Study 3.

In collaboration with my supervisors I designed and achieved ethical approval jointly with Ms. Andrea Smith a fellow PhD student, and carried out the intervention for Study 4 and 5. I conducted all 21 qualitative interviews in Study 5 and personally transcribed three interviews, with the remaining transcriptions conducted by an independent company. I carried out all the coding using NVivo, generated the themes and these were finalised with the help of Dr Beeken and Dr Fildes.

Chapter 4. Study 1: Systematic review on questionnaire measures of appetite and appetitive traits

4.1 Introduction

Appetite is a process involved in food selection and intake that demonstrates both trait and state-type elements (Chapter 2). It is stimulated by 'homeostatic' and 'hedonic' processes and, within an individual, is 'episodic' in nature, characterised by sensations of hunger or fullness (Blundell et al., 2009; Harrold et al., 2012). Appetitive traits are stable predispositions and have a more 'tonic' form of expression. They encompass a range of eating behaviour dimensions such as responding to internal and external food cues, or eating at a faster or slower rate, and are posited to play a key role in an individual's vulnerability to gain weight (Blundell et al., 2005, 2009; French et al., 2012; Harrold et al., 2012; Wardle & Carnell, 2009). Appetitive traits are thought to drive different expressions of an individual's appetite. Given the wide variability that has been shown in body weight and weight gain (Ogden, Yanovski, Carroll, & Flegal, 2007; Wardle & Boniface, 2008) (Chapter 2, Section 2.5.1), individual characteristics that interact with the environment, such as appetitive traits, have the potential to increase or decrease environmental risk.

Appetite can be measured experimentally or psychometrically, and there are advantages and disadvantages to both of these methods, as discussed in Chapter 2. While psychometric measures do not have the objectivity of experimental measures, they may be used to collect information from large numbers of people in a practical and inexpensive way. In 2012, French et al., published a selective review of the psychometric and experimental measures used to assess the relationship between appetitive traits and weight, and to capture key dimensions of eating behaviour. The specified inclusion criteria included reported associations with energy intake, food choices, body weight, or weight gain. From these measures, the authors identified seven eating dimensions that are thought to influence energy intake when expressed in a permissive food environment: 'food responsiveness', 'enjoyment of eating', 'satiety responsiveness', 'eating in the absence of hunger', 'reinforcing value of food', 'eating disinhibition' and 'impulsivity/self-control' (French et al., 2012). This review provides a helpful overview of appetitive traits that are related to energy intake, however, it was not conducted in a systematic manner,

and therefore some published questionnaires are likely to have been omitted. The psychometric strengths of existing appetitive trait measures were also not assessed.

An up-to-date systematic review of psychometric measures of appetite and appetitive traits that may influence body weight is needed to provide a better understanding of the research landscape in this area. It is important to recognise how different aspects of appetite and eating behaviour are conceptualised that could help explain individual differences in weight, and to identify measures that are psychometrically sound and age appropriate to assess these traits across the life course.

4.2 Aim

This study aimed to: (1) systematically review the relevant literature to identify existing psychometric measures of appetite; (2) assess the psychometric properties of the measure through their reliability and validity; and (3) identify the most commonly measured appetitive traits in different age groups.

4.3 Methods

4.3.1 Information sources and search strategy

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009). The search strategy was developed with the assistance of Dr Croker (HAC), Dr Beeken (RJB), and Dr Fildes (AF), following the instructions of University College London (UCL) librarians. A systematic literature search was carried out using the Embase, MEDLINE®, PsycINFO and PsychEXTRA databases to find relevant articles conducted in any country or language that were published in English until the 26th of January 2016. The search strategy included terms relating to appetite and eating behaviour; questionnaires, scales, measures and instruments; food and eating; validation, reliability, development and adaptation; and was limited to humans. See Appendix 4.1 for the complete electronic search strategy. The reference lists of all included articles were manually checked for other relevant articles.

Once the questionnaires were selected from the search and included in the qualitative synthesis, further searches using Google Scholar were carried out to make sure inclusion of validation studies, including validation of measures through experimental studies (as stated

in the inclusion criteria), and test-retest reliability. Any additional articles were then included to assess the psychometric properties of the questionnaires, but were not included as part of the original search, just referenced.

4.3.2 Eligibility criteria

Initially, all psychometric measures of appetite for adults or children published to date were included. Peer-reviewed articles in English were considered for inclusion, with the exclusion of reviews, conference abstracts, or dissertation abstracts. Measures were included if they sought to measure appetite or appetitive traits, and if the traits being measured were proposed by the authors to be related to body weight. I was interested in measures used for both general population-based samples and overweight, obese and/or clinical samples, as appetitive traits have been shown to be linearly related to weight across the whole weight spectrum (Croker et al., 2011). Measures were excluded if they: were not the original questionnaire; had not been assessed for validity or reliability and this was not included in any additional study; were experimental or laboratory-based, although these methods could be used to validate a psychometric measure; assessed attempts to control or modify appetite (including measures of self-regulation); monitored food intake, single food items, or nutrients, or food frequency; included measurement using nutritional software; measured weight control and dieting; were designed for use as a clinical diagnostic tool; or, were designed for exclusive use in a clinical population, including measures of symptoms associated with pathologically disordered eating (e.g. Anorexia Nervosa). If the measure was later used in non-pathological participants and in relation to obesity, it was still included. The inclusion and exclusion criteria for the review are shown in Table 4.1.

Table 4.1 Inclusion and exclusion criteria for a systematic review of psychometric measures of appetite

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • In humans. • Adults and children. • General population- based samples as well as overweight, obese and/or clinical samples. • Cross-sectional and longitudinal studies. • Published in English. • Peer reviewed articles • Psychometric measures of appetite which use the definition specified in sections 2.2 and 2.3 related to weight or proneness to obesity. 	<ul style="list-style-type: none"> • Reviews. • Conference abstracts. • Dissertation abstracts. • Not published in the English language. • Did not contain original questionnaire. • Did not assess the validity, reliability. • Laboratory measures of appetite or validation of laboratory measures or recording sessions (observational methodology). • Measures that monitor eating, single food items, or nutrients, food frequency, use of visual analogue scales or nutritional software. • Questionnaires which measure change or attempts to control or modify appetite. • Questionnaires relating to body image, anthropometry, malnutrition • Questionnaires relating to diseases or medical and surgical treatments (e.g. cancer, Prader-Willi Syndrome, bariatric surgery) or disabilities. • Measures of parental/caregiver feeding practices/strategies, home/school environment, social or cultural environments, external influences. • Measures of eating disorder symptoms or eating pathology (addictions, anorexia nervosa, bulimia nervosa, binge eating, etc.). • Measures related to weight control and dieting. • Diagnostic tools.

4.3.3 Study selection

Returned article titles and abstracts were initially screened using EndNote X7® referencing software, to see if any should be excluded. Those that appeared to meet the inclusion criteria were downloaded in full-text. The full-text articles were then read to confirm that they met the inclusion and exclusion criteria. When multiple articles relating to a single questionnaire were identified, either the article that was published first or the one that presented the development of the questionnaire was selected. Where appropriate, other articles were used as evidence for validity and reliability to assess the robustness of the

measures, but were not included in the final search and simply referenced. Child, adult, and parental versions of the same questionnaires were retained for inclusion. One reviewer (CH) performed the initial search, screening, and data extraction. The second reviewer (AF) checked all included articles and a sub-set of the excluded articles against the eligibility criteria.

4.3.4 Data extraction process – Classifying and coding studies

Data from the first paper describing the questionnaire or the development paper were extracted in agreement with HAC, RJB, and AF. The extracted data items, which were defined *a priori*, were: (1) Study reference, including the year of publication and country of origin, (2) aim of the measure, (3) sample size and participants involved (children, adolescents or adults), (4) age (mean±sd), (5) gender (Male/Female), (6) BMI (kg/m²; mean±sd), (7) measure response options, (8) the statistical test(s) used, as well as the number of factors and items obtained.

4.3.5 Assessing the robustness of the questionnaires

The robustness¹⁵ of the questionnaires was evaluated by assessing the psychometric properties of the measures: (1) internal reliability; (2) test-retest reliability; (3) convergent validity or when this information was not available, content or criterion validity; and, (4) discriminant validity. An overall measure of robustness based on a point system was developed. One point was awarded for each criteria met, for a total achievable score of four. Measures scoring four points were defined as being ‘robust’.

1. Evaluation of psychometric properties

The internal reliability, test-retest (external) reliability, convergent validity, and discriminant validity of measures was assessed using a pre-determined scoring system from the standards jointly published by the American Education Research Association, the American Psychological Association and the National Council on Measurement in Education (American Educational Research Association, American Psychological Association, &

¹⁵ The robustness of a measure is a term used to provide an indication of how ‘good’ the questionnaire is, i.e. it serves to assess the ‘quality’ of the questionnaire.

National Council on Measurement in Education, 1999; Streiner & Norman, 2015). The full joint standards for assessment of psychometric measures are shown in Appendix 4.2. One point was given for each of the following:

(1) Internal reliability¹⁶: Cronbach's alpha ≥ 0.7 (Field, 2013);

(2) Test-retest reliability (or external)¹⁷: Intra-class correlation coefficients ≥ 0.7 or significant Pearson's correlation coefficient or Student t-test between two time points (Field, 2013);

(3) Convergent validity¹⁸: Significant positive Pearson's correlations coefficient against another questionnaire measure of appetite; r 's in the mid-range of 0.4 to 0.8 to ensure similar attributes are being measured (Streiner & Norman, 2015). Some authors used Cohen's criteria to indicate an effect size (i.e., $r > 0.50$ a large/strong effect size; r around 0.30, a medium/moderate effect size; and r around 0.10, a slight/negligible effect size) (Cohen, 1988). In some cases, convergent validity was measured using other questionnaire measures not related to appetite but were correlated (e.g. self-esteem or social desirability), and these were also included. When convergent validity against other measures was not calculated, content, or criterion validity against the scales within the measure were included, although these last forms of validation were not considered the preferred scoring method;

¹⁶ Internal reliability shows the degree of inter-correlations which exists between the items in a scale. It measures the consistency of the scale. Assessed by Cronbach's alpha (Allison & Baskin, 2009; Streiner & Norman, 2015).

¹⁷ Test-retest (external) reliability is measured through test-retests as a measure of external consistency over time, from the first time the test was taken, to the next (Allison & Baskin, 2009; Streiner & Norman, 2015).

¹⁸ *Convergent validity* refers to the relationship between the measure and another questionnaire which measures similar constructs (e.g. Correlations between the PFS and the TFEQ-R21 'emotional eating' scale) (Allison & Baskin, 2009).

(4) Discriminant validity¹⁹: Lack of correlation between different scales or sub-scales was used to assess discriminant validity; ranges between 0.0 to ± 0.3 are considered to be negligible (Streiner & Norman, 2015).

4.3.6 Most commonly measured appetitive traits by age group

The most robust questionnaires were screened within Google Scholar to identify those that were the most commonly used based on the number of citations they had. The top three most cited were grouped by the target age group for whom the questionnaire was designed, to show which scales have been most commonly used in children and in adults.

4.4 Results

4.4.1 Search results

A total of 38 studies conducted in nine different countries were included in this systematic review (Figure 4.1). The predominant country of development of a measure was the United States ($n=18$) (Measures # 1-7, 11-13, 17, 22-23, 25,27-30; Table 4.2); five in the UK (Measures # 10, 14, 18, 35-36; Table 4.2); five in Canada (Measures # 6, 16, 19-20, 34; Table 4.2); four in the Netherlands (Measures # 9, 31-33; Table 4.2); three in Germany (Measures # 8, 24, 38; Table 4.2); one in Malaysia (Measures # 37; Table 4.2); one in Sweden (Measures # 26; Table 4.2); one in China (Measures # 15; Table 4.2); and one in Italy (Measures # 21; Table 4.2). All the questionnaires were developed and tested using cross-sectional studies and convenience sampling. Study populations varied from students (Avalos & Tylka, 2006; Tylka & Kroon Van Diest, 2013; Tylka, 2006) to obese individuals (Braet & van Strein, 1997; Schembre & Geller, 2011; Stunkard & Messick, 1985; Tanofsky-Kraff et al., 2008).

A total of 14 questionnaires were developed for use in children and adolescents (Measures # 2, 5, 15-16, 20-21, 23-24, 28, 32-33, 35-37; Table 4.2), ages two to thirteen years,

¹⁹ *Discriminant validity* refers to the lack of correlations which should exist between dissimilar unrelated variables (e.g. No associations were found between the EES sub-scales and TFEQ 'cognitive restraint') (Allison & Baskin, 2009; Streiner & Norman, 2015).

including one in infants up to 24 months (Llewellyn, van Jaarsveld, et al., 2011) and four in adolescents aged 12 to 18 years (Boggiano, Wenger, Mrug, et al., 2015; Loh et al., 2013; Rollins et al., 2014; Tanofsky-Kraff et al., 2007, 2008). Twenty-four questionnaires were developed for use in adult populations (Measures # 1, 3-4, 6-14, 17-19, 22, 25-27, 29-31, 34, 38; Table 4.2). The majority of the questionnaires used Likert-style scale response options from 1 to 5, with 14 measures using the 'never' to 'always' format (Measures # 5, 7, 9, 12, 14-15, 17, 25-28, 36-38; Table 4.2) and 10 measures using 'strongly agree' to 'strongly disagree' format (Measures # 3, 6-7, 13, 18-19, 29-31, 34; Table 4.2). Two questionnaires had a 'true' or 'false' response options (Measures # 25, 38; Table 4.2) and one questionnaire had a dichotomous 'yes' or 'no' response option (Measures # 23; Table 4.2). Other response options were seen in 13 questionnaires (Measures # 1-2, 4, 10-11, 16, 21-22, 24-27, 32; Table 4.2), and two questionnaires did not report their response options (Measures # 8, 20; Table 4.2).

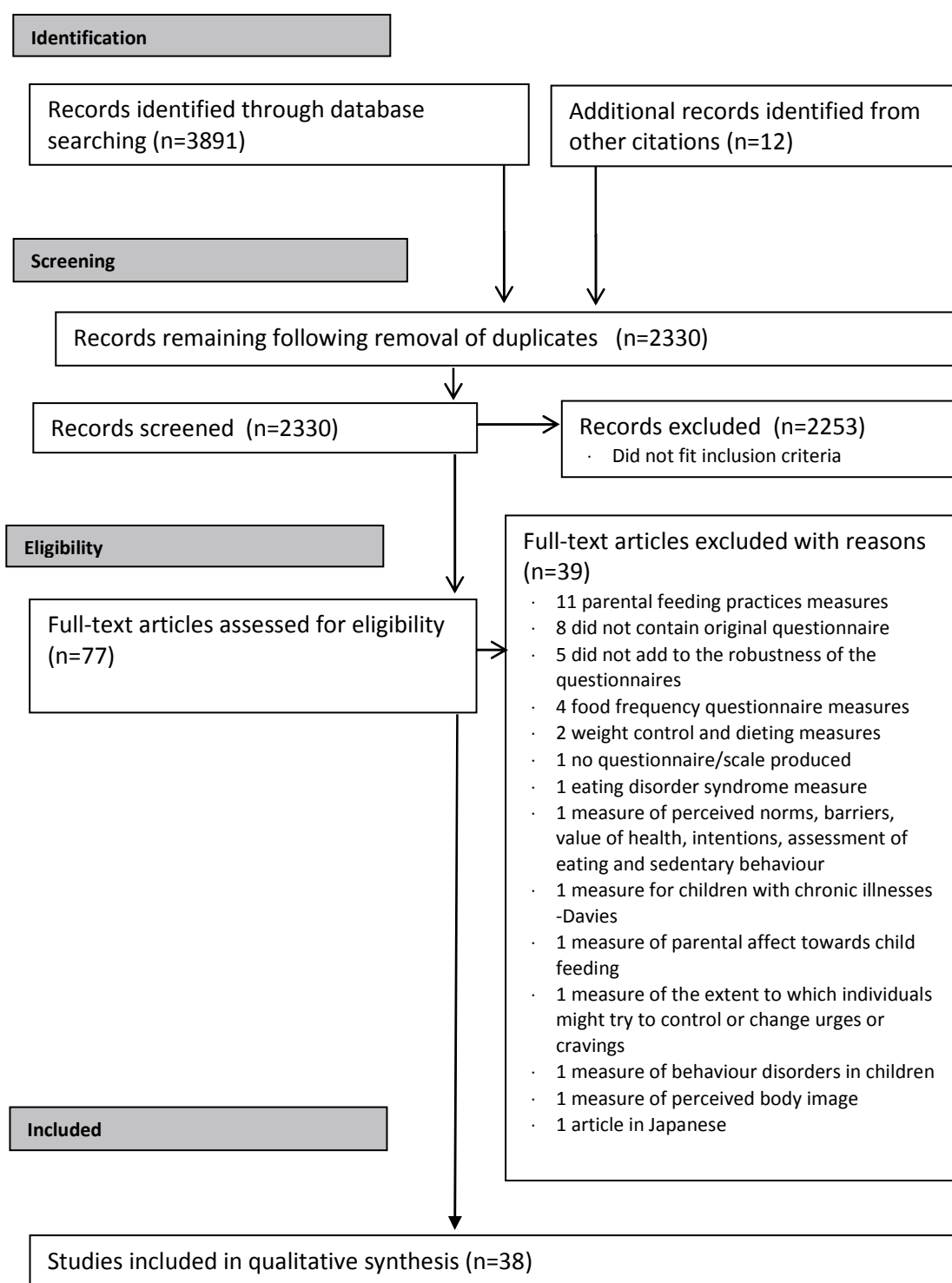


Figure 4.1 Flow chart of studies in review (based on PRISMA 2009 flow diagram).

Table 4.2 Characteristics of studies included in the systematic review

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
Emotional Eating Scale (EES)								
1	(Arnow, Kenardy, & Agras, 1995) USA	S1: to develop the item pool and investigate psychometric properties of a questionnaire to permit analysis of the relationship between negative mood and disordered eating S2: to assess the construct, discriminant, and criterion validity against the TFEQ, BES and BDI, SCL-90-R, RSE measures. S3: to assess the discriminant validity by administering it to a group of subjects diagnosed with an anxiety disorder (not reported)	S1: 47 obese females S2: 51 obese females	S1: 23 to 64 (44.9±10.4) S2: 21 to 65 45.1±10.6.	S1: 0/47 S2: 0/51	S1: 26.1 to 51.7 37.9±6.0 S2: 26.6 to 55.8 38.9±7.2	5-point scale "no desire to eat", "a small desire to eat", "a moderate desire to eat", "a strong desire to eat", "an overwhelming urge to eat,"	S1: PCA: 3 factors (25 items) Anger/Frustration (11 items) Anxiety (9 items) Depression (5 items) Cronbach α 's internal and test-retest reliability. S2: PCA, association between EES and TFEQ (and other measures) for convergent and discriminant validity
Emotional Eating Scale for use in Children and Adolescents (EES-C)								
2	(Tanofsky-Kraff et al., 2007) USA	To adapt the EES (Arnow, 1995) for use in children and adolescents (EES-C) assessed in two samples: S1: LOC S2: No LOC To assess convergent, discriminant and test-retest reliability.	59 overweight 100 non-overweight 64 test-retest S1: 18 LOC S2: 137 no LOC	8 to 18 yo (14.3±2.4) S1: (13.1±2.7) LOC S2: (14.4±2.3) no LOC	S1: 56.6%/44.4% LOC S2: 46%/54% no LOC	S1: BMI-DS (1.6±0.9) LOC S2: BMI-SDS (1.0±1.1) No LOC	5-point scale: "I have no desire to eat", through "I have a very strong desire to eat." 5-point scale: "On average, how many days a week do you eat because you feel this way?"	PCA: 3-factores (23 items) Anxiety, anger, and frustration (EES-C- AAF) (12 items); Depressive symptoms (EES-C- DEP) (7 items); Feeling unsettled (EES-C-UNS) (4 items) Cronbach α 's internal reliability, test-retest 3.4±2.6 month interval. Convergent validity: ANCOVA between LOC versus No LOC. Discriminant validity: partial correlations between EES-C subscales and measures of general psychopathology.
Eating Identity Type Inventory (EITI)								
3	(Blake, Bell, Freedman, Colabianchi, & Liese, 2013) USA	To assess how different eating identity types are related to dietary intake. To assess the construct validity of the EITI using CFA. To establish the convergent validity (against dietary intake measures) and internal and test-retest reliability of EITI	968 adults 903 CFA 94 retest reliability	57.2 ± 14.5	21.6/79.4	N/A	5-point scale: "strongly agree", to "strongly dis-agree"	CFA: revealed 11/12-items: RMSEA (.070), CFI (.937), NNFI (.925), and SRMR (.058) 4 – factors (11 items) Healthy; Meat; Picky; Emotional (number of items not reported). Cronbach α 's internal and test-retest reliability. Convergent validity: by assessing the hypothesized degree to which each eating identity type (healthy, emotional, picky, and

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
								meat) corresponded with each dietary intake measures. Pearson's correlation coefficients to assess test-retest reliability.
Palatable Eating Motives Scale (PEMS)								
4	(Burgess, Turan, Lokken, Morse, & Boggiano, 2014) USA	To identify individual motivations for eating tasty foods and to determine if certain motives would be associated with BMI.	150 College students	17 to 60 (Mean 24.4)	44/106	16.4 to 51.0 (Mean 26.3)	5-responses to choice frequency items.	PCA: 4-factor (19 items) Social (5 items) Coping (4 items) Enhancement (5 items) Conformity (5 items) Cronbach α 's internal reliability. Convergent validity: Partial correlation coefficients with BIS, BAS, YFAS and BES.
Palatable Eating Motives Scale for kids (K-PEMS)								
5	(Boggiano, Wenger, Mrug, Burgess, & Morgan, 2015) USA	To provide a preliminary validation of the K-PEMS, a self-report survey to identify individual motives for eating tasty foods in adolescents, for early identification of obesity and binge-eating risk. To determine if any specific motive(s) can account for variance in BMI and binge-eating disorder (C-BED) (Risky Eating) traits which can exacerbate obesity	73 African American adolescents	12 and 17 (14.7±0.9)	48%/52%	BMI-SDS (0.84±1.1)	5-point scale: "Never/almost never" to "Almost always/always"	PCA: 4 Factors (19 items) Social (5 items), Conformity (5 items), Reward Enhancement (5 items), Coping motives (4 items). Cronbach α 's internal reliability. Linear regressions between the K-PEMS motives and BMI-SDS and Risky Eating. Binary logistic regressions tested associations between K-PEMS motives and C-BEDS.
Power of Food Scale (PFS)								
6	(Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009) USA - Canada	To examine the factor structure of the PFS from: S1: baseline pre-treatment data of phase 3 clinical trial candidates for weight loss (including non-obese, overweight and obese subjects) S2: Web-based survey: US arm of the 2006 National Health and Wellness Survey (NHWS)	S1: 1741 obese adults S2: 1275 adults	S1: 46.3±11.0 S2: 52.5±12.8	S1: 314/1427 S2: 39% women	S1: 38.6±6.7 S2: 33.1±7.6	5-point scale: "do not agree at all" to "strongly agree"	S1: EFA: 21-item; CFA: 15-item; CFI (0.95), PNFI (0.78), ECVI (0.48) Web-based survey: CFI (0.94) Cronbach α 's internal and test-retest reliability. S2: – 15 items 3-F: Food readily available in the environment but not physically present, Food present but not tasted, and Food when first tasted but not consumed (number of items not reported). Cronbach α 's internal and test-retest reliability.

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
State and Trait Food-Cravings Questionnaires (FCQ-S and FCQ-T)								
7	(Cepeda-Benito, Gleaves, Williams, & Erath, 2000) USA	To develop, validate, and cross-validate 2 inventories for food cravings: The Food Cravings Questionnaire-State (FCQ-S) and the Food Cravings Questionnaire- Trait (FCQ-T). S1: Confirmation of factor structure, test-retest and internal reliability S2: Convergent and discriminant validity by (i) comparing food deprivation versus food satiation (<i>not reported</i>); (ii) FCQ-T/TFEQ S3: Cross-validation and CFA	S1: 217 psychology students –last 100 test-retest S2: 104 students in an elective psychology course S3: 290 psychology students	S1: 18 to 44 (21±2.98) S2: 19 to 27 (21±1.25) S3: 17 to 33 (19.3±1.85)	S1: 34%/66% S2: 30/74 S3: 169/121	N/A	5-point scale. Different options: “Never”, “rarely”, “sometimes”, “often”, “usually”, “always” “strongly disagree”, “disagree”, “neutral”, “agree”, and “strongly agree”.	S1: CFA: FCQ-T: $\chi^2[593] = 204$, $p < 0.001$; GFI=0.80; NFI=0.99; TLI=1.0; CFI = 1.0; RMSEA = 0.37 FCQ-T: 9-Factors (37-Items) Intention to consume food (3 items), Anticipation of positive reinforcement (5 items), Relief from negative states (3 items), Lack of control over eating (6 items), Preoccupation with food (6 items), Hunger (4 items), Emotions (4 items), Cues that trigger cravings (4 items), Guilt (3 items) Cronbach α 's internal reliability. S2: CFA: FCQ-S: $\chi^2[180] = 206$, $p < 0.001$; GFI=0.89; NFI=0.98; TLI=0.99; CFI = 0.99; RMSEA=0.72 FCQ-S: 5-Factors (15-Items) Intense desire to eat (3 items), Anticipation of positive reinforcement (3 items), Relief from negative state (3 items), Lack of control over eating (3 items), Hunger (3 items) Cronbach α 's internal test-retest reliability. Convergent and discriminant validity: Correlations between FCQ-T and TFEQ S3: CFA: (39-item0 (2 additional emotions items) – confirmed factor structure in S1
Brief version of the Food Craving Questionnaire-Trait (FCQ-T-r) (FCQ-T-r)								
8	(Meule, Hermann, & Kübler, 2014) Germany	To develop and validate a short form of the FCQ-T the FCQ-T-r: S1: Factor structure – online questionnaire S2: Working memory task of highly palatable foods (not reported) and RS.	S1: 323 S2: 70	S1: 24.4±5.6 S1: 22.0±3.3	S1: F=271 S2: F=70	S1: 22.0±3.4 S1: 21.5±2.8	Not reported (taken from FCQ-T, German version [Meule, 2012])	S1: PCA – one-factor (15-items) Cronbach α 's internal reliability. S2: Pearson correlation coefficients with BMI and RS.
General index of food craving (G-FCQ-T and G-FCQ-S)								
9	(Nijs, Franken, & Muris, 2007)	To assess the factor structure, validity and reliability of the modified questionnaires (G-FCQ-T and G-FCQ-S),	S1: (i) 227 (G-FCQ-T) and (ii) 119 (G-FCQ-S)	S1: (i) 17 to 28 (19.98±2.2); (ii) 17 to 28	S1: (i) 39/188; (ii) 30/89 S2: 35/170	-	5-point scale: “never” to “very often”	S1: PCA: G-FCQ-T: 4-factors (21 items) Preoccupation with food, Loss of

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
	Netherlands	Cross-sectional: S1: To test construction and EFA S2: CFA, test-retest reliability and construct validity (DEBQ). S3: Construct validity against experimental measures of satiety meal conditions (not reported).	psychology students psychology students - Test-retest (50 students)	(19.98±2.3) S2: 17 to 41 (19.86±3.2)				control (once eating), Positive outcome expectancy (from eating), Emotional craving (number of items per subscale not reported). G-FCQ-S: 5-factor (15 Items) Desire to eat, Anticipation to positive reinforcement, Anticipation to negative reinforcement, Obsessive preoccupation, raving as a physiological state (number of items per subscale not reported). Cronbach α's internal reliability, ICC test-retest reliability, Pearson correlations coefficients to assess validity against DEBQ. S2: CFA: G-FCQ-T: $\chi^2/df=2.44$, TLI=0.86, CFI=0.88; RMSEA=0.08. G-FCQ-T: $\chi^2/df=2.44$, TLI=0.86, CFI=0.88; RMSEA=0.08.
Control of Eating Questionnaire (CoEQ)								
10	(Dalton et al., 2014) UK	To assess the severity and type of food cravings an individual experiences over the previous 7 days. To examine the psychometric properties and underlying component structure in 4 samples S1, S2, S3 and S4. To examine construct validity by exploring associations with body composition and TFEQ (S1, S2, S3), and BES (S1, S2, S3 and S4).	S1: 80 S2: 50 S3: 30 S4: 55 Total sample: 215	S1: 18 to 54 (26.5±8.1) S2: 18 to 41 (24.3±5.9) S3: 20 to 54 (27.8±10.5) S4: 20 to 55 (41.0±8.7) Total sample: 29.7±10.3	S1: 26/54 S2: 0/50 S3: 0/30 S4: 18/37 Total sample: 20%/80%	S1: 18.5 to 37.7 (24.2±4.3) S2: 18.6 to 39.8 (27.1±5.4) S3: 18.8 to 29.1 (23.2±2.9) S4: 26.1 to 39.7 (24.3±5.9) Total sample: 26.4±5.2	Participants responded about their experiences over the last 7 days: 19 Items (VAS) Items 20 and 21 allowed for own response.	Originally CoEQ contained 21 Items – six sections PCA: 4 factors (17 items) Craving Control (5 items) Positive Mood (4 items) Craving for Savoury (4 items) Craving for Sweet (4 items) Cronbach α's internal reliability. Construct validity through Pearson correlation coefficients with TFEQ and BES scales.
Emotional Appetite Questionnaire (EMAQ)								
11	(Geliebter & Aversa, 2003) USA	To examine a wide array of both negative and positive emotions and situations in relation to not only overweight and normal-weight but also to underweight individuals. Authors predicted that overweight individuals would tend to overeat, whereas underweight individuals would tend to under-eat, in response to both positive and negative emotions and	90/364 questionnaires stratified by sex, and for each gender, the 15 most overweight, the 15 most underweight, and	Underweight 29.2±9.6 Normal 28.9±6.6 Overweight 33.5±11.2	Underweight 15/15 Normal 15/15 Overweight 15/15	Underweight 18.9±1.4 Normal 22.2±0.80 Overweight 29.8±2.7	9-point scale: “much less” and “much more” as anchors and 5 indicates “the same” For each item, there is	ANOVA was used to analyse responses for emotions and situations, with weight category and gender as group factors, followed by LSD post-hoc tests. EMAQ (22 items): Tendency to eat in response to positive and negative emotions

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
		situations.	the 15 closest to desirable body weight for height				also the option to indicate “not applicable” or “don’t know”	(14 items) To positive and negative situations (8 items). The positive emotion (EMAQ-PE) and positive situation (EMAQ-PS) scores can be averaged to obtain a positive EMAQ score (EMAQ-P). The negative emotion (EMAQ-NE) and negative situation (EMAQ-NS) scores can also be averaged to obtain a negative EMAQ score (EMAQ-N). Cronbach α 's internal consistency and test-retest reliability with Pearson's correlations for subscales of the questionnaire.
Motivation for Eating Scale (MFES)								
12	(Hawks, Merrill, Gast, & Hawks, 2004) USA	To develop and validate items for the Motivation for Eating Scale (MFES) as possible contributors to obesity. To assess internal and test-retest reliability, as well as concurrent and convergent validity (TFEQ and the EES and BMI)	298 (156 college students [CS], 142 community members [CM]). Test retest reliability and convergent validity (n=103)	CM were older than CS (35.5 vs. 24.8 years, p<.01)	20/224	245 normal weight 53 overweight	5-point scale: “almost”, “never”, “sometimes”, almost”, “always”.	PCA: 4 factors: Environmental eating (23 items), Emotional eating (12 items), Physical eating (9 items), Social eating (5 items) Cronbach α 's internal and test-retest reliability. Pearson correlation coefficient between scores on MFES and TFEQ, and BMI.
Intuitive Eating Scale (IES-H)								
13	(Hawks, Merrill, & Madanat, 2004) USA	To develop items and validate an instrument designed to measure the concept of intuitive eating. To test internal and test-retest reliability, as well as concurrent and convergent validity against the CBDS	391 college students Test-retest (n=285)	20.6±3.4 M (21.1±2.7) F (19.9± 4.2).	227/162	-	5-point scale: “strongly agree” to “strongly disagree”	PCA: 4-factors (27 items) Intrinsic eating (4 Items), Extrinsic eating (6 Items), Anti-dieting (13 Items), Self-care (4 Items). Cronbach α 's internal and test-retest reliability. Logistic regression to assess convergent validity with CBDS.
Mindful Eating Scale (MES)								
14	(Hulbert-Williams, et al., 2013) UK	Development of a self-report scale to measure mindfulness with respect to eating behaviours. To explore the MES against other measures of mindfulness and body acceptance.	127 university students	25.65 ± 8.89	23.8%/77.2%	23.59±3.54	4-point scale: “never”, “rarely”, “sometimes”, “usually”	EFA: 6-factors (28 items) Acceptance (6 items), Awareness (5 items), Non-reactivity (5 items), Act with Awareness (4 items),

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
								Routine (4 items) and Unstructured eating (4 items) Cronbach α 's internal reliability calculated by mean inter-item correlations. Pearson's correlation coefficient with mindfulness and body acceptance quest.
Chinese Pre-schoolers' Eating Behaviour Questionnaire (CPEBQ)								
15	(Jiang et al., 2014) China	To develop a questionnaire which can be used to evaluate Chinese pre-schoolers' problematic eating behaviours. S1: To assess the factor structure S2: To confirm the factor structure through CFA, and assess reliability, convergent and discriminant validity	S1: 313 children S2: 603 children	S1: 3 to 6 (4.3 ± 1.4) S2: 3yo (21.7%) 4yo (23.4%) 5yo (27.7%) 6yo (27.2%)	S1: 161/152 S2: 322/281	S2: OW (12.6%) OB (10.9%)	5-point scale: "never", "seldom", "sometimes", "often", "always".	S1: EFA S2: CFA (NFI=0.88, NNFI=0.91, CFI=0.92, RMSR=0.04, and SB-x2/df=1.79). 7-factors (38 items) Food fussiness (7 items), Food responsiveness (6 items), Eating habit (5 items), Satiety responsiveness (5 items), Exogenous eating (5 items), Emotional eating (5 items), Initiative eating (5 items) Cronbach α 's internal and split-half test-retest reliability. Pearson's correlations analysis was used to evaluate content validity and construct validity.
Food Situations Questionnaire (FSQ)								
16	(Loewen & Pliner, 2000) Canada	To develop and validate of a self-report measure of food neophobia for children. To validate the FSQ against measures of willingness to try new foods under laboratory conditions, and parent-report measures of their child's neophobia.	S1: 125 children S2: 335 children	S1: 5 to 12 S2: 7 to 12	Not reported	-	4-point scale: "very happy", "ok", "so-so", "very sad"	S1: EFA: 2-factors (10 items) S2: Addition of 12 filler items. EFA: 2-factors (10 items): Willingness to try novel foods in highly stimulating circumstances (HI-STIM) (5 items), Willingness to try novel foods in non-stimulating circumstances (LO-STIM) (5 items). Cronbach α 's internal consistency and test-retest reliability. Correlation coefficients of FSQ and behavioural tasks.
ecSatter Inventory (ecSI)								
17	(Lohse et. al., 2007)	To assess validity of the ecSatter Inventory (ecSI) to measure eating competence (EC).	370 – on-line survey	18 to 71 (36.2±13.4)	172/644	F (n=631) 25.7±6	5-point scale: "always", "often",	EFA and CFA: 4-factors (16 items):

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
	USA	To assess construct validity against other measures (TFEQ, EDI, FPS)	462 - paper version. 832/863 usable surveys			M (n=172) 27.0±4.9	“sometimes”, “rarely”, “never”	Eating attitudes (5 items), Food acceptance (3 items), Internal regulation (3 items), Contextual skills (5 items)
Meaning of Food Questionnaire (MOF)								
18	(Ogden, Liakopoulou, Antilliou, & Gough, 2012) UK	To assess beliefs about food and the role that these play and to evaluate the effectiveness of interventions designed to change some of these dimensions or in a clinical setting to help health professionals explore clients’ relationships to food. S1: Dieters S2: University students	S1: 451 S2: 170	S1: 37.8±11.1 S2: 20.1±4.1	S1: 6/444 S2: 84/86	S1: Normal weight 17.1% (n=77) Overweight 35.8% (n=161) Obese 47.1% (n=212)	5-point scale: “totally disagree” to “totally agree” following the statement: “to what extent do you agree with the following....”	S1: EFA – Oblimin rotation - 5-Factors S2: EFA – oblimin rotation - 6-Factors (8 subscales) 25 items: Food and sex (3 items); Control over life (6 items); Control over food (6 items); Food and family (3 items); Food as a treat (2 items); Food and emotional regulation (2 items); Food and guilt (3 items); and Food and social interaction (1 items). Cronbach α’s internal reliability.
Food Neophobia Scale (FNS)								
19	(Pliner & Hobden, 1992) Canada	To examine this neophobia-neophilia continuum in humans. To develop a paper and pencil measure of food neophobia and to examine some of the correlates of neophobia as assessed by this measure. S1: Construction of the FNS scale S2: Psychometric analysis of FNS and GNS S3: Behavioural validation (food tastings). Convergent and discriminant validity against Fear/Anxiety, Foreign food familiarity, Finickiness, and sensation seeking measures (not reported).	S1: 21, 55, 2 S2: 135, 75 S3: 41, 35, 80	S1: 18 to 74 (M=20.7) The majority were between the ages of 19 and 25.	18 to 49 (M=22.6)	-	7-point bipolar rating scale: “disagree strongly” to “agree strongly”	S1: Inter-rater correlations revealed a 18 relating to food neophobia; 12 items measured a more general neophobia (General Neophobia Scale [GNS]) S2: Uncorrected item-whole correlations for each sample: 10 item: 5 positive (neophilic) and 5 negative (neophobic) statements about food or situations related to food consumption. Cronbach α’s internal consistency and test-retest reliability. S3: Subject ratings of familiarity of foods, averaged across foods (not reported). Correlations between FNS and GNS.
Food Neophobia Scale for children (FNS-C)								
20	(Pliner, 1994) Canada	To adapt behavioural (not reported) and paper and pencil trait measures to study food neophobia in children; paired with corresponding parent’s prediction of their child’s willingness to try familiar and unfamiliar foods and overall neophobic behaviour.	117	5, 8 and 11 year old children	Age 5, M=7; Age 5, F=18; Age 8, M=20; Age 8, F=13; Age 11, M=19; Age 11, F=22	-	Not reported.	Parent-report FNS, validated against their child’s behavioural measurements (10 items) 5 positive (neophilic) and 5 negative (neophobic) statements about food or situations related

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items to food consumption
Italian Food Neophobia Scale for children (ICFNS)								
21	(Laureati, Bergamaschi, & Pagliarini, 2015) Italy	The aim of the present study was to develop and validate a self-report measure of food neophobia designed for Italian primary school children by adapting the ICFNS. Validity of the questionnaire was assessed through behavioural measurements	491/594	6 to 9 7.9 ± 1.0 years	303-291	-	5-point facial expression scale: "Very false for me," "False for me," "So-so," "True for me," "Very true for me"	(8 items) (4 neophobic and 4 neophilic items). Cronbach α 's internal consistency and test-retest reliability - Mean values for each item in the test-retest evaluation were compared through paired t-tests ($p < 0.05$).
Overeating Tension Scales (OTS)								
22	(Popkess-Vawter, Gerkovich, & Wendel, 2000) USA	To develop an Overeating Tension Scale (OTS), derived from Apter's Reversal Theory, to measure overall reported tension and motivation-specific tension. S1: Item reduction testing S2: Content validity and internal consistency S3: Testing contrast validity using contrasted groups (social gatherings, college enrolment and examination). S4: Testing OTS in normal weight and overweight women (included BULIT and MCSDS)	S1: 373 S2: 208 S3: 330 S4: 130	S1: 26 ± 9 S2: 27 ± 10 S3: 37 ± 13 S4: 35 ± 7	S1: 201/172 S2: 197/111 S3: 82/248 S4: 0/130	S1: normal weight 43%; overweight; obese 44%; Underweight 13% S2: normal weight 40%; overweight; obese 48%; underweight 12% S4: 62 normal weight and 68 overweight.	10-point continuum: "how they were feeling just before over-eating" (X), "how they wanted to feel" (O). A discrepancy score (D) equivalent to tension (O - X = D)	S1: 8 subscales (Semantic differential scales) from 48 to 32-items. Internal consistency S2: 32 Items revised. Internal consistency. Pearson's correlations S3: Cronbach α 's internal consistency. Pearson's correlations to assess validity. S4: EFA: 7 factors: serious; playful; compliant; defiant; self-centered mastery; self-centered sympathy; other-centered sympathy Cronbach α 's internal consistency. Pearson's correlations to assess convergent validity (BULIT)
Eating in Emotional Situations Questionnaire (EESQ)								
23	(Rollins et al., 2014) USA	To describe the frequency of eating in emotional situations (EES) among a sample of low-income Latino elementary-school children	159/184 low-income Latino fourth graders. A limited sample completed the external eating (n=70) and junk food (n=89) subscales.	11 to 17 (age: M=9.4, SD=.6).	45%/57.9%	-	Response option: "no", "yes".	CFA - 2-factors (11 Items): ($\chi^2=45.05$, $p=.39$; CFI=.999; RMSEA=.017). F1 - (6-items): Eating in response to psychological distress (e.g. anxiety). F2 - (5 items): Triggered by contextual cues (e.g. receiving a bad grade). Cronbach α 's internal consistency. Criterion validity of the EESQ was evaluated by correlating the EESQ scales with the food frequency and eating

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
Eating Pattern Inventory for Children (EPI-C)								
24	(Schacht, Richter-appelt, & Schultemerkwort, 2006) Germany	To evaluate and present the factor structure, psychometric properties, and initial validation data of a new self-report questionnaire on psychological dimensions of eating behaviour in children. Based on the Eating Behaviour and Weight	373 children	8 (2 children) 9 (53.1%) 10 (42.1%) 11 (14 children)	168/205	12.8 to 29.5 (17.9 ±2.8) Underweight 32 (8.6%) Overweight 57 (15.3%) – 17 (4.6%) of these were obese.	4-point scale: “not at all”, “little” “mostly”, “totally”	behaviour measures, stratified by gender. 6 factors (39 items) were taken from the Problems Inventory for Children (EWI-C) (Diehl, 1999); for 11 to 14 year olds: EFA: 4-factors (20 items) Dietary restraint (8 items) External eating (5 items) Parental pressure to eat (3 items) Emotional eating (4 items) Cronbach α's internal consistency. Pearson's correlation coefficients between scales and BMI-SDS
Three Factor Eating Questionnaire (TFEQ)								
25	(Stunkard & Messick, 1985) USA	To construct a measure that describes three dimensions of human eating behaviour: Cognitive restraint (cognitive and behavioural aspects of controlling food intake), Disinhibition (susceptibility to emotional and social cues), Hunger (eating when hungry)	S1: Restrained (78), unrestrained (62) or intermediate eaters (80) Two ancillary samples 52 and 28. S2: 53 evangelical weight program, 45 free eater S3: combined sample of 98 cases (dieters [n=53], free eaters [n=45])	S1: 17 to 77 (44±12.8) (combined)	S1:18/60 Restrained, 22/40 unrestrained, 57/23 intermediate S2:7/46 and 5/13/27didn't record gender S3: Not reported	S1: Restrained eater 50% normal weight 50% obese	Different response options: 15- response scale 6 true/false items. “True/False” “Rarely”, “sometimes”, “usually”, “always” “Not at all”, “slightly”, “moderately”, “very much”. Etc.	S1: EFA on 67 items revealed 3-factors (57 items). Cronbach α's inter-scale reliability and inter-correlations. Correlations with weight. S2: EFA on 93 items revealed 3-factors (58-items). Cronbach α's inter-scale reliability and inter-correlations. S3: EFA on 58 items revealed 3-factors (51-items): Cognitive restraint (21 Items), Disinhibition (16 Items), Hunger (14 Items). Cronbach α's inter-scale reliability and inter-correlations
Three Factor Eating Questionnaire revised version-TFEQ-R18								
26	(Karlsson et al., 2000) Sweden	To evaluate the construct validity of the TFEQ in large samples of obese men and women. To test if more efficient scales could be constructed by item reduction.	4377 obese participants of Swedish Obese Subjects Study (SOS). Two samples (2193, 2184)	37 to 57 (46.5±5.9)	1774/2603	M: 38.3±4.6 F: 41.2±6.0	Different response options: “Definitely true”, “mostly true”, “mostly false”, “definitely false” “almost never”, “seldom”, “usually”, “almost always”	Multi-trait/multi-item analysis (using EFA): 3-factors (18 Items): Cognitive restraint (6 items) Disinhibition and Hunger were grouped into Uncontrolled Eating (9 Items) Emotional Eating (3 Items) Cronbach α's internal reliability. Pearson's correlations with BMI

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
							“Unlikely/slightly”, “likely/moderately”, “likely/very likely”	and between scales to assess convergent and discriminant validity
Three Factor Eating Questionnaire revised version TFEQ-R21 _ TFEQ-R18-V2								
27	(Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009) USA Canada	To evaluate the factor structure and reliability of the TFEQ-R21, and its association with BMI, in a large obese clinical sample from the United States and Canada. To modify the structure of the TFEQ-R21, if warranted, using the clinical sample and then test the refined model in a web-based sample of obese and non-obese healthy individuals from the United States	S1: 1741 obese non-diabetic S2: 1275 web-survey	S1: 46.3±11.0 S2: 52.5±12.8	S1: 18%/82% S2: 61%/39%	S1: 38.6±6.7 S2: 33.1±7.6	4-point scale for items 1–20 (different response options) 8-point numerical rating scale for item 21.	S1: CFA in clinical sample (no constraint model). CFI: 18-Item model (0.91) best fit (TFEQ-R18V2 Cronbach α’s internal reliability and Pearson’s correlation coefficient between BMI and TFEQ- R18V2. S2: Same analysis- Web-based sample (constrained model). CFI: (0.96) Cognitive Restraint (6 items), Uncontrolled Eating (9 items), Emotional Eating (6 items). Cronbach α’s internal reliability and Pearson’s correlation coefficient between BMI and TFEQ- R18V2
Eating in the Absence of Hunger (EAH-C)								
28	(Tanofsky-Kraff et al., 2008) USA	To develop an Eating in the Absence of Hunger Questionnaire to be administered to children and adolescents (EAH-C) and to examine its psychometric properties. Cross-sectional	153 obese 73 non-obese	6 to 19 yo (14.4±2.5) Non-obese 14.2±2.5 Obese 14.9±2.4	Non-obese 48%/52% Obese 53.8%/56.2%	23% obese 68% non-obese	5-point scale: “Never” through to “Always”.	PCA – 3-factors (14 items): Negative Affect (6 items), External Eating (4 items), Fatigue/Boredom (4 items). Cronbach α’s internal and test-retest reliability. Convergent and discriminant validity (against measures of depression and anxiety).
Intuitive Eating Scale (IES)								
29	(Tylka, 2006) USA	To develop and psychometrically evaluate of a measure of Intuitive Eating (IES) [(a) unconditional permission to eat when hun-gry and what food is desired, (b) eating for physical rather than emotional reasons, and (c) reliance on internal hunger and satiety cues to determine when and how much to eat]	1260 college students S1: 391 women-EFA S2: 476 women college students-CFA S3: 199 women (who knew about study) S4: 194 women	S1: 17 to 61 (20.85±6.21) S2: 17 to 50 (19.70±4.5) S3: 17 to 55 (18.9±3.3) S4: 17 to 55 (22.1±7.38)	S1: 0/391 S2: 0/476 S3: 0/199 S4: 0/194	S3: 17.5 to 34.9 (23.50±3.90) Self-reported weight and height	5-point scale: “strongly disagree”, “disagree”, “neutral”, “agree”, “strongly agree”.	S1: EFA – 3-factors (25 items), Factor 1 (11 items), Factor 2 (8 items), Factor 3 (6 items). Cronbach α’s internal reliability and construct validity with (EAT-26). S2: CFA – 3-factors (21 Items) CFI=0.91, TLI=0.90, RMSEA=0.80, SRMR=0.07 Unconditional permission to eat (9 items); Eating for physical rather than emotional reasons (6

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
								items); Reliance on internal hunger/satiety cues (6 items) Internal reliability and construct validity with other measures. S3: Correlations of IES to BMI S4: Test-retest reliability
	Intuitive Eating Scale–2:							
30	(Tylka & Kroon Van Diest, 2013) USA	Item refinement and psychometric evaluation of IES with college women and men.	S1: 878 Test-retest 219 S2: 1200 S3: 522	S1: 18 to 56 (20.4±5.2) Test-retest 18 to 47 (20.3±4.6) S2: 18 to 53 (20.5±5.1) S3: 18 to 56 (20.3±4.8)	S1: 391/487 Test-retest 79/140 S2: 520/680 S3:284/238	S2: F: 15.98 to 56.25 (24.0±5.7) M: 16.5 to 59.1 (25.4±5.5)	5-point scale: “strongly disagree”, “disagree”, “neutral”, “agree”, “strongly agree”	S1: EFA and CFA separate in M and F: 23-item IES-2 contained 11 original items and 12 added items. 4 factors: 3 Original IES factor + Body–Food Choice Congruence. Cronbach α’s internal reliability, construct validity with IES, test-retest reliability. S2: CFA: Factor structure from S1 in M and F: CFI=0.96, SRMR=0.06, RMSEA=0.05, 90% CI [0.050, 0.057], χ ² (206, n=1200) = 908.31, p<0.001. Unconditional permission to eat (8 items); Eating for physical rather than emotional reasons (6 items); Reliance on internal hunger/satiety cues (6 items); Body–Food Choice Congruence (3 items) Cronbach α’s internal reliability, construct validity with eating and body-related variables and psychological wellbeing indices. S3: Discriminant validity with social desirability scales
	Dutch Eating Behaviour Questionnaire (DEBQ)							
31	(van Strein et al., 1986) Netherlands	To develop a questionnaire containing three scales: restrained eating, emotional eating and external eating. S1: Item pool development from 100 items. S2: To devise distinct scales for EE and ExtE and administer to two samples. S3: To develop a final item pool and also to assess the dimensional stability of this item pool in sub-samples of obese and non-obese subjects, and men and women, and then to replicate the factor	S1: 120 subjects S2: (i) 264 (ii) 93 S3: 91 obese; 566 non-obese S3: M=517 F=653	S1: M=(30.8±5.2) F=(31.1±8.4) S2: (i) M=(23.6±2.8) F=(22.9 ± 4.1) (ii) M=(31.0±8.3) F=(31.1 ± 8.6) S3: full sample reported in (Baecke, Burema,	S1: 40/80 S2: (i) M=103 (26.8±4.5) F=161 (29.9±4.7) (ii) M=(31.1± 2.9) F=(32.8 ± 6.2) S3: full sample reported in (Baecke et al.,	S1: M=(26.2± 5.4) F=(25.2 ± 4.8) S2: (i) M=(23.6±2.8) F=(22.9 ± 4.1) (ii) S3: full sample reported in (Baecke et al., 1983)	5-point scale: “never”, “seldom”, “sometimes”, “often”, “very often”	S1: Item pool development from 100 items: PCA: 3-factors (51 items). S2: PCA on 51 items administered to two samples: EE comprised 2 factors (clearly labelled emotions and diffuse emotions). S3: From S2, items were revised and new items developed (48

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		structures obtained in the preliminary studies.		Frijters, Hautvast, & van der Wiel-Wetzels, 1983)	1983)			items). PCA: EE comprised 2 factors (same as above). Construction of final scale (33 items): Restrained (10 items), emotional eating (13 items), and external eating (10 items). Cronbach α 's internal reliability. Descriptive statistics and subscale Pearson's correlations coefficients.
Children's Dutch Eating Behaviour Questionnaire (DEBQ-C)								
32	(van Strein & Oosterveld, 2008) Netherlands	To construct an age adapted version of the DEBQ for measurement of restrained, emotional and external eating in 7- to 12-year-old children: the DEBQ-C S1: Item pool development. S2: To determine the reliability, inter-correlations, and correlations with other measures (e.g. other risk factors for overweight such as snacking, skipping breakfast, physical inactivity, and time spend with screen media, parental feeding styles and body dissatisfaction)	S1: 769 children S2: 515 children – additional validation	S1: 9.6±1.4 (7 to 12) S2: B 9.30±1.44 G 9.30±1.47	S1: 382/387 S2: 252/263	S1: 81.4% normal weight 18.6% overweight	3-point scale: “No”, “sometimes”, “yes”.	S1: PCA on 37 items, revealed a 3-factors (20 items). Cronbach α 's internal reliability. S2: CFA: RMSEA=0.031, p=1.0, $\chi^2(187) = 286$, p<0.001, $\chi^2/df=1.71$. Restrained (7 items), emotional (7 items), and external eating (6 items) Multi-group model for testing construct invariance for BMI-status.
Dutch Eating Behaviour Questionnaire parent version (DEBQ-P)								
33	(Braet & van Strein, 1997) Netherlands	To assess eating patterns in children using the parent version of the DEBQ, the DEBQ-P, and focus on obese and non-obese youngsters. To explore specifically the relationships among EE, ExtE, and caloric intake. To test the relationship between EE and ExtE-induced eating against psychological measures of emotionality and externality in children.	292 children + parents 145 Overweight 147 Normal weight	9 to 12 (10.5±0.9)	Overweight 52/93 Normal weight 58/89	Overweight 49.3%±19.7 Normal weight ±9%IBW	5-point scale: “never”, “seldom”, “sometimes”, “often”, “very often” Items adapted to parental report version.	EFA: 3-factors (33 items) Cronbach α 's internal reliability. ANOVA for each DEBQ scale: sex (male, female) by group (obese, non-obese).
Hunger Sensitivity Scale (HSS)								
34	(Walker, Hadjistavropoulos, Gagnon, & MacNab, 2015) Canada	To develop and validate the hunger sensitivity scale (a cognitive eating style associated with heightened distress in response to hunger sensations) S1: Conceptual grounds for item generation and factor analysis. S2: Test-retest and discriminant validity (TFEQ plus other measures of general anxiety, depression and anxiety sensitivity.)	S1: 556 university students S2: 101 university students on a diet or had been on a diet (47/85 test-retest)	S1: 24.6±0.41 S2: 22.4±5.76	S1: 121/435 S2: 15/86 (test-retest 7/40)		6-point scale: (0) “strongly disagree” to (6) “strongly agree”	S1: Item analysis of the 29-item scale. Parallel analysis, then EFA (50% sample) and CFA (50% sample): 1 factor (13 items) CMIN/df=2.01, RMSEA=0.6, ECVI=0.66. Cronbach α 's internal reliability. S2: Cronbach α 's internal and test-retest reliability. Convergent and discriminant

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Child Eating Behaviour Questionnaire (CEBQ)								
35	(Wardle, Guthrie, et al., 2001) UK	To develop and validate a questionnaire to assess eating style in young children through parental report. S1: Evaluation of existing literature S2: (i) Interviews with parents about their children's eating; (ii) Pilot study S3: Internal consistency in 2 samples of parents S4: PCA to third sample of parents. Test-retest 2 weeks later. Gender and age differences were analysed.	S2: (i) 15 parents (2 to 6 yo); (ii) 131 parents S3: 187 parents S4: 208 parents Test-retest: 160 parents	S2: (ii) 2 to 7 (4.2±1.3) S4: 5.6±1.5	S3: 100/78 (4 no gender indicated) S4: 111/97	-	5-point scale: "never", "seldom", "sometimes", "often", "always" (scored 0–4).	validity (against TFEQ and measures of depression and anxiety). S2: (ii) PCA on 57 items revealed 7-factors (35 items) Cronbach α 's internal reliability. S3: PCA: 7-factors (35 items): Food responsiveness (5 items); Enjoyment of food (4 items); Emotional over-eating (4 items); Desire to drink (3 items); Satiety responsiveness (5 items)/Slowness in eating (4 items); Emotional under-eating (4 items); Fussiness (6 items). Cronbach α 's internal and test-retest reliability. Correlations between scales and age and gender differences using ANOVA.
Baby Eating Behaviour Questionnaire (BEBQ)								
36	(Llewellyn, van Jaarsveld, et al., 2011) UK	To describe the development and factor structure of the BEBQ an infant version of the CEBQ that measures four appetitive traits in infants who are still exclusively fed milk, related to weight. S1: Development of the questionnaire. Pilot study with 33 mothers of twins. S2: Gemini Study – Assessment of the factor structure	S1: 33 mothers of twins S2: 2402 infants	S1: 2 to 24 months S2: 4 to 20 months (M: 8 months)	S2: 1194/1208	Weight at birth: 2.5±0.55	5-point scale: "never", "rarely", "sometimes", "often", "always"	S2: PCA – 4-factors (18 items): Enjoyment of food (4 items); Food responsiveness (6 items); Slowness in eating (4 items); Satiety responsiveness (4 items); plus (1 appetite item: 'My baby had a big appetite') Cronbach α 's internal reliability. T-tests and ANOVAs were used to assess group differences across all of the scale. Pearson's correlation coefficient was used to explore associations between birth weight SDS and normally distributed BEBQ scales, Spearman's r was used for 'enjoyment of food' and birth weight SDS.
Self-report measure of the CEBQ for 13 year old adolescents (CEBQ-self-report)								
37	(Loh et al., 2013) Malaysia	To adapt of the CEBQ as a self-report among adolescents in a Malaysian population. Cross-sectional – two phase study:	S1: 362, test-retest n=133 S2: 646	13	S1: M (59.7%) S2: M=182(26.8),	IOTF cut-off points	5-point scale: "never", "rarely", "sometimes", "often",	S1: CFA: 9-factors (35-item). FF was split into two. Cronbach α 's internal and test-

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
		S1: Construct validation S2: Associations w/BMI			F=464(73.2)	S2: Underweight=52(8.0%) Normal weight=422(65.3%) Overweight=104(16.1%) Obese=68(10.5%)	"always"	retest reliability. S2: CFA: 8-factors (30-item), yielded an improved model fit. ($\chi^2/df = 3.686$, CFI =0.850, TLI = 0.815, GFI = 0.736, AGFI = 0.773, RMSEA =0.065). Food responsiveness (5 items), Enjoyment of food (4 items), Emotional over-eating (4 items), Desire to drink (3 items), Slowness in eating (4 items), Emotional under-eating (4 items) and Food fussiness 1 (FF1) (4 items); Food fussiness 2 (FF2) (4 items) (as two different concepts; dislike towards food (FF1) and trying new food (FF2). Associations between eating behaviour and BMI z-scores were examined with complex samples general linear model (GLM) analyses, adjusted for gender, ethnicity and maternal educational level.
Flexible and Rigid Control Dimensions of Dietary Restraint								
	(Westenhoefer, 1991) Germany	To examine if restrained eaters in fact restrain food intake. S1: Participants were subdivided into 17 groups according to their level of disinhibition. S2: Examined whether there are distinctive types of restrained eating behaviour, one associated with high disinhibition, the other with low disinhibition of control.	54,525 participants in a computer-aided training program for weight reduction.	M 45.6±12.2 F 43.6±12.7	8393/ 46132	M 28.2±3.2 F 27.2±3.8	Different response options: "true", "false" "usually", "always", "moderately", "very much", "often", "always"	Cognitive restraint subscale of the EI (Stunkard & Messick, 1985) is divided into flexible and rigid control strategies of dietary restraint. S1: Mean scores for item on the RS were computed by subgroups of disinhibition and tested for linear relation to the disinhibition scores, and for deviations from linearity. S2: Test of linearity and deviation between high and low scores of disinhibition (ANOVAs) From the results of discriminant analysis, two ad hoc scales were built from the restraint items having the most discriminating power:
38								

#	Reference (Country)	Aim	Sample composition	Age (mean±sd)	Gender M/F	BMI kg/m ² (mean±sd)	Response option	Statistical analysis/Factors/Items
								Flexible control (12 items) (FC12). Rigid control (16 items) (RC16).

S1, S2, S3, etc. = Study 1, Study 2, Study 3

AGFI: Adjusted Goodness of Fit Index; CFA = Confirmatory Factor Analysis; CFI: Comparative Fit Index; ECVI: Expected Cross Validation Index;

EFA: Exploratory Factor Analysis; EPCA: Exploratory principal component analysis; GFI: Goodness-of-Fit Index; PNFI: Parsimonious Normed Fit Index;

RMSEA: Root Mean Square Error of Approximation; TLI: Tucker-Lewis Index; SEM = Structural Equation Modelling.

Mo = Mothers, Fa = Fathers; M=male, F=Female, B=boys, G=girls

EE: Emotional Eating; ExtE: External Eating; RE: Restrained Eating.

LOC: Loss of Control; No LOC: No Loss of Control.

AAQ: Acceptance and Action Questionnaire II; BAQ: Body Attitude Questionnaire; BAS: Behavioural Activation Scale; BDI: Psychological adjustment; BES: Binge Eating Scale; BIS: Behavioural Inhibition Scale; BULIT: CBDS: Cognitive Behavioural Dieting Scale; EDE-Q: Eating Disorder Examination Questionnaire; EDI: Eating Disorder Inventory;

FMPS: Frost Multidimensional Perfectionism Scale; FPS: Food Preference Survey; LOC: Loss of Control; MAAS: Mindfulness Attention Awareness Scale;

MCSDS: Marlowe-Crowne Social Desirability Scale; RSE: Self-esteem; SCL-90-R: Psychological adjustment; VAS=Visual Analogue Scale; WPI: Weight Problems Inventory; YFAS: Yale Food Addiction Scale.

BEBQ: Baby Eating Behaviour Questionnaire; CEBQ: Child Eating Behaviour Questionnaire; CEBQ-self-report: Self-report measure of the CEBQ; CPEBQ: Chinese Pre-schoolers' Eating Behaviour Questionnaire; CoEQ: Control of Eating Questionnaire; DEBQ: Dutch Eating Behaviour Questionnaire; DEBQ-C: Children's Dutch Eating Behaviour Questionnaire; DEBQ-P: Dutch Eating Behaviour Questionnaire parent version; EAH-C: Eating in the Absence of Hunger; ecSI: ecSatter Inventory; EES: Emotional Eating Scale; EESQ: Eating in Emotional Situations Questionnaire; EES-C: Emotional Eating Scale; EITI: Eating Identity Type Inventory; EMAQ: Emotional Appetite Questionnaire; EPI-C: Eating Pattern Inventory for Children; FCQ-S and FCQ-T: State and Trait Food Cravings Questionnaires; FCQ-T-r and FCQ-T-r: Brief version of the Food Craving Questionnaire-Trait; FSQ: food Situations Questionnaire; FNS: Food Neophobia Scale; FNS-C: Food Neophobia Scale for children; G-FCQ-T and G-FCQ-S: General index of food craving; HSS: Hunger Sensitivity Scale; ICFNS: Italian Food Neophobia Scale for children; IES: Intuitive Eating Scale; IES-2: Intuitive Eating Scale-2; IES-H: Intuitive Eating Scale-H; K-PEMS: Palatable Eating Motives Scale for kids; MES: Mindful Eating Scale; MOF: Meaning of Food Questionnaire; OTS: Overeating Tension Scales; PEMS: Palatable Eating Motives Scale; PFS: Power of Food Scale; MFES: Motivation for Eating Scale; TFEQ: Three Factor Eating Questionnaire; TFEQ-R18: Three Factor Eating Questionnaire revised version; Three Factor Eating Questionnaire revised version TFEQ-R21 _TFEQ-R18-V2.

4.4.2 Evaluation of psychometric properties: Reliability and validity of the questionnaires

The majority of studies reported reliability and validity of their scales. Table 4.3 shows the results of the psychometric evaluation of the questionnaires (see Appendix 4.3 for an extended version of the psychometric evaluation of the questionnaires). All questionnaires provided measures of internal reliability, and the majority carried out test-retest reliability, except for 10 measures (Boggiano et al., 2015; Braet & van Strein, 1997; Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Dalton et al., 2014; Hulbert-Williams et al., 2013; Karlsson et al., 2000; Llewellyn et al., 2011; Ogden et al., 2012; Pliner, 1994; Popkess-Vawter et al., 2000; Schacht et al., 2006). The majority of questionnaires were validated using convergent validity, except for five measures which used content validity (Jiang et al., 2014; Llewellyn, van Jaarsveld, et al., 2011; van Strein et al., 1986; van Strein & Oosterveld, 2008; Wardle, Guthrie, et al., 2001). One measure used criterion validity (Rollins et al., 2014), and seven measures did not provide any validity results (Boggiano et al., 2015; Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Hawks et al., 2004; Loh et al., 2013; Ogden et al., 2012; Schacht et al., 2006). Five questionnaires used behavioural measures to validate the questionnaires: The Food Situations Questionnaire (FSQ), the Food Neophobia Scale (FNS), the FNS-C in children, the Italian version of the FNS (IFNC), and the CEBQ (Laureati et al., 2015; Loewen & Pliner, 2000; Pliner & Hobden, 1992; Pliner, 1994; Wardle, Guthrie, et al., 2001). A total of 20 questionnaires did not measure discriminant validity (Measures # 3, 5, 8, 10-16, 18, 20-24, 27, 32-33, 36; Table 4.3).

4.4.3 Overall robustness of the questionnaires

A total of 17 questionnaires obtained a 4-point score: the 'Emotional Eating Scale' (EES) (Arnouk et al., 1995), the 'Emotional Eating Scale' for children (EES-C) (Tanofsky-Kraff et al., 2007), the 'Palatable Eating Motives Scale' (PEMS) (Burgess et al., 2014), the 'Power of Food Scale' (PFS) (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009), the 'State and Trait Food-Cravings Questionnaires' (FCQ-S and FCQ-T) (Cepeda-Benito et al., 2000), the 'General index of food craving' (G-FCQ-T and G-FCQ-S) (Nijs et al., 2007), the 'Emotional Appetite Questionnaire' (EMAQ) (Geliebter & Aversa, 2003), the Intuitive Eating Scale (IES-H) (Hawks et al., 2004), the 'Food Neophobia Scale' (FNS) (Pliner & Hobden, 1992), the TFEQ (Stunkard & Messick, 1985), the 'Eating in the Absence of Hunger' questionnaire (EAH-C) (Tanofsky-Kraff et al., 2008), a second 'Intuitive Eating Scale' scale (IES) (Tylka, 2006), the 'Intuitive Eating Scale-2' (IES-2) (Tylka & Kroon Van Diest, 2013), the

DEBQ (van Strein et al., 1986), the 'Hunger Sensitivity Scale' (HSS) (Walker et al., 2015), the CEBQ (Wardle, Guthrie, Sanderson, & Rapoport, 2001) and the 'Flexible Control' and 'Rigid Control' dimensions of 'dietary restraint' (Westenhoefer, 1991). The majority of the questionnaires obtained a score of 2 or 3 points (n=16). Five questionnaires obtained a 1-point score (Boggiano, Wenger, Mrug, et al., 2015; Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Ogden et al., 2012; Pliner, 1994; Schacht et al., 2006).

The majority of the 17 robust questionnaires identified were adult measures, with only three specifically for use in children: the 'Emotional Eating Scale' for children (EES-C) (Tanofsky-Kraff et al., 2007), the 'Eating in the Absence of Hunger' questionnaire (EAH-C) (Tanofsky-Kraff et al., 2008), and the CEBQ (Wardle, Guthrie, et al., 2001).

Table 4.3 Validity and reliability measures of questionnaires from the systematic review

	Reference	Internal reliability	Test-retest reliability	Convergent/content /criterion validity	Discriminant validity	Psychometric evaluation
Emotional Eating Scale (EES)						
1	(Arnow et al., 1995)	✓	✓	✓	✓	4
Emotional Eating Scale - Adapted for use in Children and Adolescents (EES-C)						
2	(Tanofsky-Kraff et al., 2007)	✓	✓	✓	✓	4
Eating Identity Type Inventory (EITI)						
3	(Blake et al., 2013)	✓	✓	✓	-	3
Palatable Eating Motives Scale (PEMS)						
4	(Burgess et al., 2014)	✓	(Boggiano et al., 2015) ✓	✓	✓	4
Palatable Eating Motives Scale for kids (K-PEMS)						
5	(Boggiano, Wenger, Mrug, Burgess, & Morgan, 2015)	✓	-	-	-	1
Power of Food Scale (PFS)						
6	(Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009)	✓	(Lowe et al., 2009) ✓	✓	✓	4
State and Trait Food-Cravings Questionnaires (FCQ-S and FCQ-T)						
7	(Cepeda-Benito et al., 2000)	✓	✓	✓	✓	4
Brief version of the Food Craving Questionnaire-Trait (FCQ-T) (FCQ-T-r)						
8	(Meule et al., 2014)	✓	-	✓	-	2
General index of food craving (G-FCQ-T and G-FCQ-S)						
9	(Nijs et al., 2007)	✓	✓	✓	✓	4
Control of Eating Questionnaire (CoEQ)						
10	(Dalton et al., 2014)	✓	-	✓	✓	4
Emotional Appetite Questionnaire (EMAQ)						
11	(Geliebter & Aversa, 2003)	✓	✓	(Nolan, Halperin, & Geliebter, 2010) ✓	(Nolan et al., 2010) ✓	4

Motivation for Eating Scale (MFES)						
12	(Hawks, Merrill, & Madanat, 2004)	✓	✓	✓	-	3
Intuitive Eating Scale (IES-H)						
13	(Hawks et al., 2004)	✓	✓	✓	✓	4
Mindful Eating Scale (MES)						
14	(Hulbert-Williams et al., 2014)	✓	-	✓	-	2
Chinese Pre-schoolers' Eating Behaviour Questionnaire (CPEBQ)						
15	(Jiang et al., 2014)	✓	✓	✓	-	3
Food Situations Questionnaire (FSQ)						
16	(Loewen & Pliner, 2000)	✓	✓	✓	-	2
ecSatter Inventory (ecSI)						
17	(Lohse et al., 2007)	✓	(Stotts & Lohse, 2007) ✓	✓	-	3
Meaning of Food Questionnaire (MOF)						
18	(Ogden et al., 2012)	✓	-	-	-	1
Food Neophobia Scale (FNS)						
19	(Pliner & Hobden, 1992)	✓	✓	✓	✓	4
Food Neophobia Scale for children (FNS-C)						
20	(Pliner, 1994)	-	-	✓	-	1
Italian Food Neophobia Scale for children (ICFNS)						
21	(Laureati et al., 2015)	✓	✓	✓	-	3
Overeating Tension Scales (OTS)						
22	(Popkess-Vawter et al., 2000)	✓	-	✓	-	2
Eating in Emotional Situations Questionnaire (EESQ)						
23	(Rollins et al., 2014)	✓	-	✓	-	2
Eating Pattern Inventory for Children (EPI-C)						
24	(Schacht et al., 2006)	✓	-	-	-	1
Three Factor Eating Questionnaire (TFEQ)						
25	(Stunkard & Messick, 1985)	✓	(Ganley, 1988) ✓	(Gormally, Black, Daston, & Rardin, 1982) ✓	✓	4

Three Factor Eating Questionnaire revised version TFEQ-R18						
26	(Karlsson et al., 2000)	✓	-	✓	✓	3
Three Factor Eating Questionnaire revised version TFEQ-R21 _ TFEQ-R18-V2						
27	(Cappelleri, Bushmakim, Gerber, Leidy, Sexton, Lowe, et al., 2009)	✓	-	-	-	1
Eating in the Absence of Hunger (EAH-C)						
28	(Tanofsky-Kraff et al., 2008)	✓	✓	✓	✓	4
Intuitive Eating Scale (IES)						
29	(Tylka, 2006)	✓	✓	(Avalos & Tylka, 2006) ✓	✓	4
Intuitive Eating Scale–2						
30	(Tylka & Kroon Van Diest, 2013)	✓	✓	✓	✓	4
Dutch Eating Behaviour Questionnaire (DEBQ)						
31	(van Strein et al., 1986)	✓	(Banasiak, Wertheim, Koerner, & Voudouris, 2001) ✓	(Cebolla, Barrada, Van Strein, Oliver, & Baños, 2014; J Wardle, 1987a) ✓	(van Strein, 2002) ✓	4
Children’s Dutch Eating Behaviour Questionnaire (DEBQ - C)						
32	(van Strein & Oosterveld, 2008)	✓	(Baños et al., 2011) ✓	✓	-	3
Dutch Eating Behaviour Questionnaire parent version (DEBQ-P)						
33	(Braet & van Strein, 1997)	(Caccialanza et al., 2004) ✓	-	✓	-	2
Hunger Sensitivity Scale (HSS)						
34	(Walker et al., 2015)	✓	✓	✓	✓	4
Child Eating Behaviour Questionnaire (CEBQ)						
35	(Wardle, Guthrie, et al., 2001)	✓	✓	(Carnell & Wardle, 2007) ✓	(Carnell & Wardle, 2007) ✓	4
Baby Eating Behaviour Questionnaire (BEBQ)						
36	(Llewellyn, van Jaarsveld, et al., 2011)	✓	-	✓	-	2
Self-report measure of the CEBQ						
37	(Loh et al., 2013)	✓	✓	-	-	2

Flexible and Rigid Control Dimensions of Dietary Restraint					
38	(Westenhoefer, 1991)	✓	(Westenhoefer et al., 1999) ✓	(Westenhoefer et al., 1999) ✓	4

+ve: Positive significant associations with BMI or BMI-SDS

-ve: Negative significant associations with BMI or BMI-SDS

PA: Partial associations with BMI or BMI-SDS and only some of the sub-scales within the measure.

NA: No associations with any sub-scales within the measure.

BEBQ: Baby Eating Behaviour Questionnaire; CEBQ: Child Eating Behaviour Questionnaire; CEBQ-self-report: Self-report measure of the CEBQ; CPEBQ: Chinese Pre-schoolers' Eating Behaviour Questionnaire; CoEQ: Control of Eating Questionnaire; DEBQ: Dutch Eating Behaviour Questionnaire; DEBQ-C: Children's Dutch Eating Behaviour Questionnaire; DEBQ-P: Dutch Eating Behaviour Questionnaire parent version; EAH-C: Eating in the Absence of Hunger; ecSI: ecSatter Inventory; EES: Emotional Eating Scale; EESQ: Eating in Emotional Situations Questionnaire; EES-C: Emotional Eating Scale; EITI: Eating Identity Type Inventory; EMAQ: Emotional Appetite Questionnaire; EPI-C: Eating Pattern Inventory for Children; FCQ-S and FCQ-T: State and Trait Food-Cravings Questionnaires; FCQ-T-r and FCQ-T-r: Brief version of the Food Craving Questionnaire-Trait; FSQ: food Situations Questionnaire; FNS: Food Neophobia Scale; FNS-C: Food Neophobia Scale for children; G-FCQ-T and G-FCQ-S: General index of food craving; HSS: Hunger Sensitivity Scale; ICFNS: Italian Food Neophobia Scale for children; IES: Intuitive Eating Scale; IES-2: Intuitive Eating Scale-2; IES-H: Intuitive Eating Scale-H; K-PEMS: Palatable Eating Motives Scale for kids; MES: Mindful Eating Scale; MOF: Meaning of Food Questionnaire; OTS: Overeating Tension Scales; PEMS: Palatable Eating Motives Scale; PFS: Power of Food Scale; MFES: Motivation for Eating Scale; TFEQ: Three Factor Eating Questionnaire; TFEQ-R18: Three Factor Eating Questionnaire revised version; Three Factor Eating Questionnaire revised version TFEQ-R21 _TFEQ-R18-V2.

4.4.4 Most commonly measured appetitive traits by age group

Google Scholar screening of the 17 most robust questionnaires showed a range of citations from zero for the 'Hunger Sensitivity Scale' (HSS) to 3020 publications for the TFEQ. The three most highly cited questionnaires were the TFEQ (3020 citations), the DEBQ (1700 citations) and the CEBQ (460 citations). All of the traits measured fall within one of three theory based categories: 'restraint', 'emotional' and 'food and eating/externality'.

The TFEQ has been used in adolescents as well as adults (Gallant et al., 2010); and revised versions of the TFEQ, the TFEQ-R18 and the TFEQ-R21 or TFEQ-R18-V2 have also been used, although they are not fully robust. The DEBQ has also been used in children and adolescents, either reported by the young person themselves using the DEBQ-C, or using a parent-report version, the DEBQ-P (Braet & van Strein, 1997; van Strein & Oosterveld, 2008); although neither of these obtained a 4-point score for robustness within the previous section. The CEBQ has only been used in children, the infant version, the BEBQ, used in babies (Llewellyn, van Jaarsveld, et al., 2011), and in 13 year old Malay adolescents as a self-report version (Loh et al., 2013), though again the psychometric properties of these versions have not been fully tested. The sub-scales of these three measures and their use in adult and child eating behaviour research is shown below in Table 4.4.

Table 4.4 The three most commonly used psychometric measures of appetite and the traits they measure by age group: The TFEQ (3020 citations), the DEBQ (1700 citations) and the CEBQ (460 citations) ^a

Theory-based categories	Traits	Children and adolescents	Adults	Psychometric questionnaires
Restraint	Cognitive restraint or Restraint	✓	✓	TFEQ + DEBQ, DEBQ-C, DEBQ-P
Emotional	Disinhibition	✓	✓	TFEQ
	Emotional eating	✓	✓	DEBQ, DEBQ-C, DEBQ-P, TFEQ-R18, TFEQ-R21
	Emotional over and under eating	✓		CEBQ, CEBQ self-report
Food and eating/Externality	External eating	✓	✓	DEBQ, DEBQ-C, DEBQ-P
	Food responsiveness	✓		CEBQ, BEBQ, CEBQ self-report
	Hunger	✓	✓	TFEQ
	Satiety responsiveness	✓		CEBQ, BEBQ, CEBQ self-report
	Enjoyment of food	✓		CEBQ, BEBQ, CEBQ self-report
	Slowness in eating	✓		CEBQ, BEBQ, CEBQ self-report
	Food fussiness	✓		CEBQ, CEBQ self-report ^b
	Desire to drink	✓		CEBQ, CEBQ self-report

^a Based on Google Scholar citations.

BEBQ: Baby Eating Behaviour Questionnaire; CEBQ: Child Eating Behaviour Questionnaire; CEBQ self-report: Self-report version of the Child Eating Behaviour Questionnaire; DEBQ: Dutch Eating Behaviour Questionnaire; TFEQ: Three factor Eating Questionnaire; TFEQ-R18: revised version of the TFEQ, TFEQ-R21: revised version of the TFEQ.

^b 'Food fussiness' is split into two factors 'food fussiness-1' and 'food fussiness-2'

4.5 Discussion

This systematic review identified 38 existing psychometric questionnaire measures of appetite. Of these, 14 were measures developed for use in children (including four in adolescents and one in infants), and 24 in adults. Nine different countries were

represented by the questionnaires and associated research. Several different response options were found in the 38 appetite measures within this study. Likert-like response formats from “never”, to “always”, or “strongly disagree”, to “strongly agree”, were the most common. Seventeen questionnaires were found to have a high level of robustness, shown by a maximum 4-point score based on one point given each for: good internal reliability, test-retest reliability, convergent validity and discriminant validity (Arnow et al., 1995; Burgess et al., 2014; Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009; Cepeda-Benito, Gleaves, Williams, et al., 2000; Geliebter & Aversa, 2003; Hawks et al., 2004; Pliner & Hobden, 1992; Stunkard & Messick, 1985; Tanofsky-Kraff et al., 2008, 2007; Tylka & Kroon Van Diest, 2013; Tylka, 2006; van Strein et al., 1986; Walker et al., 2015; Wardle, Guthrie, et al., 2001).

Twenty-one measures did not receive the full score for psychometric strength. Some of these measures, which were deemed non-robust according to the point system implemented, have not been widely used, such as the ‘Over-eating Tension Scales’ (OTS), which was developed in 2000 to report tension and motivation-specific tension surrounding eating and was only found to be cited on four occasions (n=4 citations) (Popkess-Vawter, Gerkovich, & Wendel, 2000). In a few cases, low citation counts may be due to the measures being developed recently, and further validation of the scales may still be under way. This could apply for the ‘Italian Food Neophobia Scale’ for children (ICFNS) a self-report adaptation of the ‘Food Neophobia Scale’ for children and adolescents (Laureati et al., 2015) or the ‘Palatable Eating Motives Scale’ for kids (K-PEMS) that attempts to identify individual motives for eating tasty foods in adolescents (Boggiano, Wenger, Mrug, Burgess, & Morgan, 2015) to cite only a few examples.

Only 11 measures were examined for convergent or discriminant validity using other measures of appetite, and the majority of comparisons (n=7) were in relation to the TFEQ (Arnow et al., 1995; Cepeda-Benito, Gleaves, Williams, et al., 2000; Dalton et al., 2014; Hawks et al., 2004; Lohse et al., 2007; Walker et al., 2015; Westenhoefer, 1991). Two robust measures used experimental validation of their questionnaires (Carnell & Wardle, 2007; Pliner & Hobden, 1992; Wardle, Guthrie, et al., 2001), the ‘Food Neophobia Scale (FNS) and the CEBQ.

As expected, the most commonly used measures of appetite were the TFEQ, DEBQ and the CEBQ. The traits captured by these measures were ‘restraint’, ‘disinhibition’ and ‘hunger’ measured using the TFEQ in adults and adolescents ages 12 to 17 years old (Gallant et al.,

2010; Stunkard & Messick, 1985); ‘external eating’, ‘emotional eating’ and ‘restraint’ measured using the DEBQ in adults (van Strein et al., 1986), the DEBQ-P as a parent report of these measures in nine to 12 year old children (Braet & van Strein, 1997), and as self-report in seven to 12 year old children using the DEBQ-C (van Strein & Oosterveld, 2008); ‘emotional eating’ has also been measured in adults using the adapted versions of the TFEQ, the TFEQ-R18 and the TFEQ-R21 or TFEQ-R18-V2 (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Karlsson et al., 2000); and ‘food responsiveness’, ‘enjoyment of food’, ‘emotional over-eating’, ‘desire to drink’, ‘satiety responsiveness’, ‘emotional under-eating’, ‘food fussiness’ and ‘slowness in eating’ in three to 12-year-old children using the CEBQ, and ‘food responsiveness’, ‘enjoyment of food’, ‘satiety responsiveness’, and ‘slowness in eating’ using the BEBQ in infants aged four to 20 months. The same traits measured in the CEBQ have also been adapted for use in 13 year old Malay adolescents (Loh et al., 2013). However, the confirmatory factor analysis revealed a different factor structure to the CEBQ (9 sub-scales vs. 8 sub-scales), separating the ‘food fussiness’ sub-scale into two measures: ‘food fussiness-1’ and ‘food fussiness-2’, and adding sugar-sweetened beverages (SSBs) to the ‘desire to drink’ items to express what types of drinks the items referred to when assessing liquid consumption. This self-report version of the CEBQ has not been validated in adult samples.

Overall, the traits captured by these three most commonly used measures, relate predominantly to three different aspects of eating; ‘emotional’, ‘restraint’ and ‘food and eating/externality’. These aspects of appetite, derive from three of the main theories of obesity which have been posited to date: (1) the “Psychosomatic” theory, which proposes that dysphoric mood is part of the aetiology of obesity (Kaplan & Kaplan, 1957); (2) the “Restraint” theory, which posits that pathological aspects ‘external’ and ‘emotional eating’ are consequences of dieting (Herman, Polivy, Pliner, Threlkeld, & Munic, 1978; Herman & Polivy, 1975; Polivy & Herman, 1976b); and (3) the “Externality” theory which suggest that individuals over-eat based on external and lack of internal satiety cues (Schachter & Gross, 1968; Schachter, 1968). These three aspects of appetite are captured not only by those measures which were identified as being the most common, but in general appeared to inform all 17 of the robust measures of appetitive traits.

4.5.1 Measures that encompass ‘emotional’ aspects of appetite

‘Emotional eating’ has been the specific focus of individual questionnaires (Arnouk et al., 1995; Geliebter & Aversa, 2003; Tanofsky-Kraff et al., 2007), as well as being measured by

sub-scales within broader questionnaires (Burgess et al., 2014; Cepeda-Benito, Gleaves, Williams, et al., 2000; Nijs et al., 2007; Stunkard & Messick, 1985; van Strein et al., 1986; Wardle, Guthrie, et al., 2001). These measures have been developed for both children (Tanofsky-Kraff et al., 2007; Wardle, Guthrie, et al., 2001) and adults (Arnou et al., 1995; Burgess et al., 2014; Cepeda-Benito et al., 2000; Geliebter & Aversa, 2003; Nijs et al., 2007; Stunkard & Messick, 1985; van Strein et al., 1986). Overall, the 'Emotional Eating Scale' (EES), and the 'emotional eating' (EE) sub-scale of the DEBQ-EE, together with the 'emotional eating' sub-scales of the revised measures of the TFEQ, the TFEQ-R18, and the TFEQ-R21 or TFEQ-R18-V2 (which did not fall within the most robust measures in this systematic review), measure 'emotional eating' in adults across a wide range of emotions. These measures have been mainly used to study participants with disordered eating or binge-related obesity spectrums, and differences in associations between 'emotional eating' and BMI obtained using different TFEQ versions, suggest that multiple factors related to dieting issues and not only emotions are still at play (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Karlsson, Persson, Sjöström, & Sullivan, 2000). Thus, the interaction between these different measures of 'emotional eating' still require further studies, particularly in different populations.

In children, positive associations between BMI and 'emotional eating' have not always been found using measures such as the 'Emotional Eating Scale' adapted for use in children and adolescents (EES-C), the DEBQ-C, the DEBQ-P, and the CEBQ (Baños et al., 2011; Braet & van Strein, 1997; Croker et al., 2011; Santos et al., 2011; Tanofsky-Kraff et al., 2007; van Strein & Oosterveld, 2008; Wardle, 1987a). These conflicting results have led to the suggestion that adults have a greater capacity than children to discriminate between their emotions (Braet & van Strein, 1997). Overall, there is very little research on whether these constructs interact with each other, to measure similar aspects of 'emotional eating'. For example, significant positive associations were found between the EES 'Anger/Frustration and Depression' sub-scales and the 'disinhibition' sub-scale of the TFEQ (Arnou et al., 1995). Given the majority of these measure were developed in the light of the "Psychosomatic" theory (Kaplan & Kaplan, 1957), the issue is still argued as to whether the 'emotional eating' is brought on by dieting or disordered eating, and whether it is a cause or consequence of excess weight. Interestingly, the CEBQ is the only questionnaire to measure 'emotional eating' in the light of research surrounding variation in the eating styles hypothesised to predispose one to weight gain and obesity (Wardle, Guthrie, et al.,

2001), rather than in the context of disordered eating. The CEBQ also measures 'emotional under-eating', a sub-scale that is currently not measured in adults.

4.5.2 Measures that encompass 'restraint' aspects of appetite

A total of three questionnaires which measure 'restraint' were found to be robust: the TFEQ, the DEBQ and the 'Flexible Control' and 'Rigid Control' sub-scales of the TFEQ 'restraint' scale (Stunkard & Messick, 1985; van Strein et al., 1986; Westenhoefer, 1991). All measures of 'restraint' originate from the 'Restraint Scale' (RS). The RS was initially developed as a self-report measure of chronic dieting for the purpose of weight control (Herman & Mack, 1975; Herman & Polivy, 1975), and therefore did not meet the inclusion criteria to be included in this study. The RS is not considered a valid measure of 'restrained eating', as it also contains items that measure dieting strategies, weight fluctuation and 'disinhibition' (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Herman & Polivy, 1975; Stunkard & Messick, 1985). The measurements of aspects of 'disinhibition' and 'restraint' are confounded with each other in the RS (Johnson et al., 2012; Meule, Papies, & Kübler, 2012). The TFEQ and the DEBQ were developed to try and eliminate this confounding from the RS (Stunkard & Messick, 1985; van Strein et al., 1986). The TFEQ 'cognitive restraint' and the 'Flexible Control' and 'Rigid Control' dimensions of the 'restraint' assess the relationships between 'restraint', 'disinhibition' and disordered eating (Stunkard & Messick, 1985; Westenhoefer et al., 1999; Westenhoefer, 1991). The DEBQ, on the other hand, measures only 'dietary restraint' (van Strein et al., 1986). Other scales that were not found to be sufficiently robust in this review have also been used to measure 'restraint' (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009; Jiang et al., 2014; Karlsson et al., 2000).

A number of conflicting results surround the measurement of 'restraint' and its relationship with BMI (Anglé et al., 2009; de Lauzon-Guillain et al., 2006; Williamson et al., 1995) (Chapter 2, Section 2.5.3). However, it is clear from citations of the TFEQ (3020 citations) and the DEBQ (1700 citations), that 'restraint' has received great attention and research into 'restraint' covers all age ranges from childhood and adolescence to adulthood. 'Restraint' has also been studied longitudinally in adults and adolescents (Drapeau et al., 2003; Johnson & Wardle, 2005; Svensson et al., 2014). Comparisons between different measures of 'restraint' (such as differences between the RS, the TFEQ, the DEBQ and the Flexible and Rigid control dimensions of 'restraint') have also been carried out (Laessle, Tuschl, Kotthaus, & Pirke, 1989; Williamson et al., 2007) which suggests that further

development of 'restraint' scales are unwarranted. 'Restraint' is not captured by the CEBQ because the CEBQ was designed to capture those aspects of eating thought to have a biological basis, whereas 'restraint' is thought to be psychologically driven (Wardle, Guthrie, et al., 2001).

4.5.3 Measures that encompass 'food and eating/externality' aspects of appetite

The majority of robust questionnaires (n=14), fall into those which measure aspects of 'food and eating/externality' (Burgess et al., 2014; Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009; Cepeda-Benito et al., 2000; Geliebter & Aversa, 2003; Hawks, Merrill, & Madanat, 2004; Nijs et al., 2007; Pliner & Hobden, 1992; Stunkard & Messick, 1985; Tanofsky-Kraff et al., 2008; Tylka & Kroon Van Diest, 2013; Tylka, 2006; van Strein et al., 1986; Walker et al., 2015). Only two of these measures were specifically developed for children, the 'Eating in the Absence of Hunger' questionnaire (EAH-C) and the CEBQ (Tanofsky-Kraff et al., 2008; Wardle, Guthrie, et al., 2001). All robust questionnaires except the CEBQ measure only one or two specific aspect of 'food and eating/externality'. For example, the 'Palatable Eating Motives scale' (PEMS), assesses motivations for eating tasty foods through the 'conformity' and 'social' motives scales (Burgess et al., 2014). Neither of these sub-scales have been found to be associated with BMI in 169 college students (Boggiano et al., 2015). The newly developed 'Hunger Sensitivity Scale' (HSS) assesses emotional aspects of hunger, but it measures behavioural changes such as snacking and eating around others who are eating, as external triggers to internal satiety sensitivity (Walker et al., 2015). The HSS has been validated against the 'hunger' sub-scale of the TFEQ (Stunkard & Messick, 1985; Walker et al., 2015), and it shows promise as a new measure assessing 'hunger sensitivity'; but BMI was not associated with HSS scores in a sample of 556 university students (Walker et al., 2015). The 'hunger' sub-scale of the TFEQ on the other hand, has shown inconsistent relationship with BMI (Lindroos et al., 1997; Stunkard & Messick, 1985). Other multi-faceted measures of appetite, such as the DEBQ and the CEBQ, do not contain measures of 'hunger'; consequently, psychometric measures of 'hunger' still rely on the TFEQ (Stunkard & Messick, 1985). Previous research suggests that those who struggle with hunger could also experience cravings and disordered eating (Elfhag & Rössner, 2005; Finlayson et al., 2007).

A further measure which was found to be robust was the 'Power of Food Scale' (PFS) (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009; Lowe et al., 2009). The

PFS is one of the most recently developed and widely used instruments (74 citations) that measures appetite related to living in a food-abundant environment and it has been validated against the TFEQ-R21 or TFEQ-R18-V2 (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Lowe, et al., 2009). The PFS has shown no significant associations between any of its three sub-scales and BMI (Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009). Also not associated to BMI, the 'Food Neophobia Scale' (FNS) in adults (Pliner & Hobden, 1992) also obtained a 4-point score for robustness. These results differ from a similar concept related to neophobia, such as 'food fussiness' measured using the CEBQ in children which has been negatively associated with weight in a few studies (Hill et al., 2009; Loh et al., 2013; Mallan et al., 2013; Rodenburg et al., 2012; Spence et al., 2011; Viana et al., 2008) (Chapter 2, Section 2.5.3). No other measure of 'food fussiness' was seen in these robust questionnaires in adults.

'External eating' was first measured using the DEBQ (10 items), and its associations with weight have been inconsistent (Schachter, 1968; van Strein, 1986; Wardle, 1987; Wardle et al., 1992) (Chapter 2, Section 2.5.3). 'External eating' measured using the DEBQ-P (the parent-report version of the DEBQ) was significantly associated with BMI in one study (Braet & van Strein, 1997), although it did not significantly differ between obese, overweight and normal weight groups of children in another study (Caccialanza et al., 2004). The DEBQ has also been developed as a self-report measure, modified to be answered by nine to 12 year olds in a version known as the DEBQ-C (Baños et al., 2011; van Strein & Oosterveld, 2008). The CEBQ construct 'food responsiveness', which contains five items related to response to external food cues, has been consistently positively associated with BMI-SDS scores in children (Croker et al., 2011; Sleddens, Kremers, & Thijs, 2008; Viana et al., 2008). Some of the inconsistencies in the associations observed between 'external eating' and weight may be driven by 'emotional eating' (as a predictor of over-eating), rather than by eating in response to food cues (Koenders & Van Strein, 2011).

Recently there has been interest in the measurement of 'intuitive eating'; four of the 38 scales reviewed measured this aspect of eating (Hawks, Merrill, & Madanat, 2004; Hulbert-Williams, Nicholls, Joy, & Hulbert-Williams, 2013; Tylka & Kroon Van Diest, 2013; Tylka, 2006). 'Intuitive eating' has been associated to a tendency to eat following physical hunger and internal satiety cues to help determine what and how much you eat and is said to be an aspect of eating which relies on internal sensations. Three measures of 'intuitive eating' were found to be robust, the IES and IES-2 and the IES-H scales (Hawks, Merrill, & Madanat,

2004; Tylka & Kroon Van Diest, 2013; Tylka, 2006). The IES has been cited in 161 publications to date since it was developed in 2006 (Tylka & Kroon Van Diest, 2013; Tylka, 2006), making it one of the preferred measures in the present literature, although it has yet to reach the number of citations achieved by older measures. All three 'intuitive eating' scales have been found to be negatively associated to BMI in predominantly white college students (Hawks, Merrill, & Madanat, 2004; Tylka & Kroon Van Diest, 2013; Tylka, 2006). Intuitive eating shows some resemblance to the 'satiety responsiveness' scale in the CEBQ, which measures eating in response to internal satiety cues. However, a closer look at the items reveals the CEBQ measures a sensation of fullness (e.g. "I often leave food on my plate at the end of a meal", "I often get full before my meal is finished", "I get full up easily"), compared to a reliance on intuitive measures of satiety in the IES ("I trust my body to tell me when...", "I trust my body to tell me what...", "I trust my body to tell me how much"), in children vs adults. Given the possible similarities between 'intuitive eating' and constructs such as 'satiety responsiveness' measured by the CEBQ, differences between these measurements should be identified through convergent/discriminant validity studies and in similar age ranges. This would help determine if future scale development would benefit from inclusion of measures of both intuitive internal satiety cues and responsiveness to satiety.

4.5.4 Limitations

Several limitations of the present study should be acknowledged. The robustness indicator of psychometric measures was based on both reliability and validity studies. In the last few decades validity studies have changed from a focus on whether the test measures what it is intended to measure to the study of participants' characteristics and what scores they achieved (Cronbach, 1951; Streiner & Norman, 2015). Thus, although authors might suggest that the measure which they obtained is valid, this might only refer to the use it serves in a particular group of people and the context in which it was tested (Streiner & Norman, 2015). Consequently, older measures, which have been tested in numerous settings and under different conditions (such as the TFEQ, the DEBQ, or the EES) are considered to be psychometrically sound measures and are used in different studies to assess convergent and discriminant validity.

Validation of measures against other similar instruments, although the most common method of convergent validity, is sometimes difficult to justify if a particular set of measures already exists (Streiner & Norman, 2015). Other forms of psychometric

validation could be carried out through behavioural/laboratory validations, providing objective measures of specific traits that serve to validate psychometric measures (Carnell & Wardle, 2007). Five measures have been tested using these types of studies, the 'Food Situations Questionnaire' (FSQ) (Loewen & Pliner, 2000), the Food Neophobia Scale in children (FNS-C), the Italian version of the FNS, a self-report measure in children (ICFNS), and the CEBQ (Carnell & Wardle, 2007; Laureati et al., 2015; Loewen & Pliner, 2000; Pliner & Hobden, 1992; Pliner, 1994). Of these, the CEBQ and the FNS were two measures which were found to score 4-points for robustness (Carnell & Wardle, 2007). However, when behavioural measures are correlated against psychometric measures for validation purposes, it is unclear what size of correlation should be obtained to support the scale being a valid measure of a trait (Carnell & Wardle, 2007). Contemporary questionnaires tend to include reliability and validity measures in their publications, obtained from exploratory and confirmatory factor analysis on different samples.

Given the results from this search are based on published studies, the review is prone to publication bias. It is unknown how many studies reporting associations between questionnaire measures of appetite and other factors such as BMI with non-significant results have remained unpublished. Sampling bias from convenience sampling used to obtain participants for questionnaire validation is also an issue. Studies using psychometric questionnaires require the use of validation studies in different samples to assess their generalisability (Allison & Baskin, 2009; Streiner & Norman, 2015). Where studies used clinical samples, individuals in obesity clinics and treatment centres for disordered eating are those most likely to have participated, leaving out participants with these conditions but no access to treatment. In studies with university or college students, those who were included generally gained credits for participating in the study, possibly excluding students who were not interested in the course. All of these scenarios could result in the inclusion of poorly designed studies that are unreliable due to samples that do not represent the populations they are supposed to. Further studies using the measures in different samples, would provide further reliability and validity results that could potentially eliminate this problem, however this is costly and time consuming (Streiner & Norman, 2015).

Given the wide definition of appetite (Section 2.2), it is impossible to include all of its broader elements. Only 'trait' aspects of appetite were included in this review, which were related to weight and thought to be present across the whole weight spectrum. For example, a newly developed 'Culturally-based Communication about Health, Eating, and

Food' (CHEF) scale, was removed from the search on the basis that these constructs cannot be viewed as 'traits' (Hubbard et al., 2015). Measures of parental feeding practices such as the 'Child Feeding Questionnaire' (CFQ) were also excluded (Birch et al., 2001).

Questionnaires that specifically measured dimensions of eating disorders, were also not included in the study. Samples of participants with eating disorders were included only if the scale had subsequently been used in non-pathological conditions. It is therefore possible that appetite measures developed in clinical samples, but which might be beneficial for use in non-pathological populations were omitted.

4.5.5 Conclusions

From this review, 38 existing psychometric questionnaires used to measure different aspects of appetite related to weight were identified. Of these, a total of 17 had high robustness scores, assessed using a 4-point scoring system. These 17 questionnaires measure different traits which broadly describe 'emotional', 'restraint' and 'food and eating/externality' aspects of appetite. Of the most robust measures, the CEBQ used laboratory-based measures to demonstrate the validity of different aspects of food and eating of the questionnaire. The three most frequently cited questionnaires were the TFEQ and the DEBQ, which are used mainly in adults, and the CEBQ, which is used in children. These three questionnaires have been used extensively in many countries and have allowed an improved understanding of different appetitive traits.

This review identified several traits measured in children that have no parallel psychometric measure for adults. There is currently no psychometric measure of 'satiety responsiveness', assessing responsiveness to fullness sensations unrelated to intuition for adults. 'Emotional under-eating' captured by the CEBQ has also not been measured in adults. 'External eating' has been measured in adults using the DEBQ, but this measure has not been consistently associated with BMI, in contrast to the similar construct 'food responsiveness' from the CEBQ, which has been consistently associated with a degree of overweight in children. Therefore, adult measures of 'satiety responsiveness', 'emotional under-eating' and 'food responsiveness' would be useful to allow for exploration of the impact of these traits on weight into adulthood. Presently, these traits as well as others such as 'enjoyment of food', 'slowness in eating', 'food fussiness', and 'desire to drink' may be validly measured in children using the CEBQ. An adult version of the CEBQ would extend the applicability of this measure to another life-stage, allowing longitudinal analysis in future with older age groups. This review supports the need to develop a measure of

appetitive traits in adults that encompasses broader measures of appetitive traits not related to 'restraint' and 'disinhibition', including measurements of sensitivity to internal and external food cues.

Chapter 5. Study 2: Development of the 'Adult Eating Behaviour Questionnaire'²⁰

5.1 Background

The results from the systematic review in Study 1, Chapter 4, highlighted a number of existing valid and reliable questionnaires that measure appetite. The most commonly used measures of appetite in adults are the TFEQ (Stunkard & Messick, 1985), the DEBQ (van Strein et al., 1986). In children, the CEBQ is the most comprehensive measure and was originally developed for use in the UK. The CEBQ encompasses aspects of food and eating, as well as emotional aspects of appetite. It also includes other constructs not addressed in the adult literature, such as 'satiety responsiveness' and 'enjoyment of food', 'emotional under-eating', 'slowness in eating', and 'food responsiveness' which is unrelated to 'restraint' or 'disinhibition'.

The CEBQ has been validated for use in children from different ethnic and cultural backgrounds, including Australian children aged one to five-year-old (Mallan et al., 2013), and low-income Hispanic and African American children aged two to five years in the USA (Sparks & Radnitz, 2012). The CEBQ has been used extensively to assess the relationship between appetitive traits and weight at different ages (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Soussignan, Schaal, Boulanger, Gaillet, & Jiang, 2012; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009), in different populations, and in different languages (Santos et al., 2011; Sleddens et al., 2008; Soussignan et al., 2012; Viana et al., 2008). It has also been used to assess differences in appetitive traits in obese populations and in clinical settings (Croker et al., 2011).

²⁰ A version of this chapter has been accepted for publication: Hunot, C., Fildes, A., Croker, H., Llewellyn, C. H., Wardle, J., & Beeken, R. J. (2016). Appetitive traits and relationships with BMI in adults: Development of the Adult Eating Behaviour Questionnaire. *Appetite*. <http://dx.doi.org/10.1016/j.appet.2016.05.024>. A copy of this paper is presented in Appendix 5.1.

Versions of this chapter were also presented at conferences (Appendix 5.2).

Some of the most important work carried out using the CEBQ, has focused on the relationship between 'food responsiveness' and BMI-SDS, finding positive associations between this trait and weight in multiple samples (Carnell & Wardle, 2008a; Croker et al., 2011; Santos et al., 2011; Viana et al., 2008). 'External eating' (a similar construct to 'food responsiveness') has also been measured using the DEBQ (van Strein et al., 1986) and its child report (van Strein & Oosterveld, 2008) and parent report (Braet & van Strein, 1997) versions. However, reported associations between this trait and BMI have been mixed, including positive associations (van Strein et al., 1986), negative associations (Baños et al., 2011), or no associations at all (Caccialanza et al., 2004). These inconsistent findings might reflect the fact that the DEBQ was designed to assess clinically disordered eating behaviour and may therefore be less applicable to non-clinical samples, in contrast to the CEBQ, which was designed to capture a normal range of eating styles.

There is some evidence from studies using the CEBQ that appetitive traits vary with age (Ashcroft et al., 2008). However, studies exploring changes in appetitive traits across the life course have been limited by the lack of a comparable self-report measure of appetitive traits for adults. There has been increased interest from clinicians and researchers who would like to use the CEBQ in adult populations as weight gain is more common at older ages and appetitive traits may influence this.

The systematic review of the existing psychometric measures of appetite and appetitive traits in the previous chapter, shows that there is no measure in adults that encompasses the aspects of appetite captured by the CEBQ (Wardle, Guthrie, et al., 2001). In particular, there is no comparable measure of 'food responsiveness' and 'satiety responsiveness', neither of which have been adequately captured by existing measures of appetite in adulthood. Measurement of these traits in adults would contribute to our understanding of how these specific traits influence weight gain at older ages (French et al., 2012). Together with the BEBQ (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2011), an infant version of the CEBQ, the addition of the 'Adult Eating Behaviour Questionnaire' (AEBQ) would enable these eating traits to be measured across the life course using three life-stage appropriate instruments. This would make it possible to longitudinally track appetitive traits from infancy (BEBQ) and childhood (CEBQ) into adulthood (AEBQ), to give a better picture of the association between appetitive traits and weight across the life-course. As mentioned previously in Chapter 1, Section 1.4, appetitive trait scores (using

the AEBQ) could also serve to inform interventions, tailoring weight loss and weight management advice to an individual's appetitive trait profile.

5.2 Aims

The aim of this study was to develop an internally reliable self-report 'Adult Eating Behaviour Questionnaire'. The specific objectives were to: (1) adapt a prototype self-report AEBQ from the parent-report 'Child Eating Behaviour Questionnaire' (CEBQ); (2) pilot the AEBQ in samples of adults; and (3) assess the factor structure of the AEBQ to ascertain the appetitive traits measured by the questionnaire.

5.3 Methods

Preliminary work was carried out to adapt the CEBQ into a self-report measure for adults. The decision over which items were selected to be adapted and included in the AEBQ was based on: (1) The translation of parent-report items into self-report items; (2) findings from the systematic review (Chapter 4), and input from experts on eating behaviour to develop new items to measure 'hunger' in a self-report format, as 'hunger' was not assessed in the CEBQ; and (3) piloting in a sample of adults.

5.3.1 Translation of the CEBQ into the AEBQ

Initially, the wording of all 35 CEBQ items was changed from the parent-report "My child...." format to a self-report "I" format (e.g. "My child loves food" was changed into "I love food"). The original response format of the CEBQ ('never', 'rarely', 'sometimes', 'often' and 'always') was kept (see Appendix 5.3). The CEBQ item, "My child eats more when s/he is happy" loads onto the 'emotional under-eating' scale (Wardle, Guthrie, et al., 2001). It was of interest that a CEBQ item describing eating more in response to a positive emotion loaded onto a construct or scale for 'emotional under-eating', so questions were added denoting both directions of emotional responses for items on the 'emotional under-eating' and 'emotional over-eating' scales, in order to confirm which AEBQ constructs they would load onto. This meant an additional four 'emotional over-eating' items ("I eat more when I am angry"; "I eat more when I am upset"; "I eat more when I am tired" and "I eat more when I am bored") and an additional six 'emotional under-eating' items ("I eat less when I am happy"; "I eat less when I am annoyed"; "I eat less when I am anxious"; "I eat less when

I am worried"; "I eat less when I am bored"; and "I eat less when I have nothing else to do") were added, in addition to those already contained in the CEBQ. This increased the original questionnaire from 35 to 45 items.

This early version of the AEBQ with the literal translation of each CEBQ item into a self-report format was given to 10 adults (eight females and two males; mean age 31.9 ± 7.8) to complete and provide initial feedback. Further refining of the questionnaire took place in group discussions with psychologists, dieticians, and experts in eating behaviour ($n=4$). Based on these discussions and feedback, the three items from the 'desire to drink' scale of the CEBQ were eliminated because this scale was deemed difficult to complete. Questions such as "My child is always asking for a drink", which in the AEBQ became "I am always asking for a drink", were also considered difficult for adults to answer as became unclear what type of drink was being referred to (e.g. alcoholic or non-alcoholic). Furthermore, the item "my child is always asking for food" from the 'food responsiveness' scale in the CEBQ, which became "I am always asking for food" in the AEBQ, was also perceived to be inappropriate for an adult to respond to. Therefore, the three items from the 'desire to drink' scale, and the "I am always asking for food" item from the 'food responsiveness' scale were eliminated, leaving 41 remaining items.

5.3.2 Review of items from other questionnaires on appetite from existing literature

Following examination of the main appetite dimensions measured in the systematic review in Study 1, Chapter 4, Section 4.4.4, it became apparent that the self-report format of the CEBQ did not contain a measure of 'hunger' experience. 'Hunger' is an important aspect of appetite that could not be measured in the CEBQ, as parents are unable to determine their child's experienced level of physical hunger and would only be able to report on their behaviours in relation to food (Wardle et al., 2013).

'Hunger' is measured by 14 items in the TFEQ-R18, a shortened version of the TFEQ (de Lauzon et al., 2004). However, these items fall within the 'uncontrolled eating' construct of the TFEQ-R18, with items such as, "I am usually so hungry that I eat more than three times a day" and "Dieting is so hard for me because I just get too hungry". Other items such as, "I often get so hungry that my stomach feels like it will never be full up" and "I am always hungry enough to eat at any time" are items that relate to 'restraint' and 'disinhibition' which, as discussed in the review (Chapter 4, Section 4.5.2), are not the purpose of the

AEBQ. Therefore, none of the TFEQ-R18 'hunger' items were deemed appropriate for use in the AEBQ.

'Hunger' measurements were also examined in the 'ecSatter Inventory' (ecSI) (Lohse et al., 2007; Stotts & Lohse, 2007), including the 'experiential process of hunger' sub-scale with one item, "I eat as much as I am hungry for", which seems inadequate as a measure of 'hunger', as it does not attempt to quantify the level or frequency of physical 'hunger' (Wardle, 1987b). A further measure examined was the 'Intuitive Eating Scale', which measures 'reliance on internal hunger and satiety cues' to determine when and how much to eat (Avalos & Tylka, 2006; Tylka & Kroon Van Diest, 2013; Tylka, 2006). Here, the ability to interpret internal signals of satiety are measured with items such as "I can tell when I am slightly full/slightly hungry", "I trust my body to tell me when...(to eat)". Again, this scale does not attempt to measure the level or frequency with which physical 'hunger' is experienced.

As none of these questionnaires capture differences in experienced levels of physical 'hunger' unrelated to emotional or restraining situations and after discussion with a panel of clinical psychologists, behavioural scientists, dieticians and authors of the original CEBQ, I felt it was important to find questions to reflect the physical experience of hunger that could be incorporated into the AEBQ. A set of questions used in the Weight Concern 'Shape-Up' manual to help participants distinguish between 'hunger' or 'craving' appeared to capture this physical 'hunger' (Wardle et al., 2013). Weight Concern is a registered charity, set up in 1997 to tackle the rising problem of obesity in the UK (Weight Concern, 2016a). Part of the work it does is through 'Shape-Up', a lifestyle programme that helps individuals to manage their weight and improve their health and quality of life. A clinical psychologist with considerable experience of working with obese patients developed the five items on 'hunger'. These items were therefore added to the AEBQ to measure the level of physical hunger that a person experiences: "I often notice my stomach rumbling"; "I often feel so hungry that I have to eat something right away"; "If I miss a meal I get irritable"; "I am always hungry at certain times of the day"; and "If my meals are delayed I get light-headed" (Appendix 5.4).

Measures related to desire to eat when in the presence of palatable food (which relate to 'food responsiveness') were also not included in the CEBQ, again because parents would be unable to answer about their children's eating. Items from other questionnaires were therefore considered for inclusion. This included the 'external eating' construct of the

DEBQ (“If food smells and looks good, do you eat more than usual?”; “If you see or smell something delicious, do you have a desire to eat it?”; “If you walk past the baker, do you have the desire to buy something delicious?”) (van Strein et al., 1986), the ‘uncontrolled eating’ scale from the TFEQ-R18 (“When I see or smell really delicious foods, I find it very difficult to keep from eating - even if I’ve just finished a meal”) (de Lauzon et al., 2004), and one item from the ‘Power of Food Scale’ (PFS) (“If I see or smell a food I like, I get a powerful urge to have some”) (Lowe et al., 2009). Although these items were thought to be clearly worded measures of a person’s interest in food and drive to eat, the experts on eating behaviour recommended that specific items should be developed for the AEBQ that captured ‘food responsiveness’ more specifically, as defined by Schachter (1968) (such as wanting to eat in the presence of others eating, or wanting to eat when seeing or smelling food). Thus, three ‘food responsiveness’ items were developed and added for piloting: “I am always thinking about food”, “When I see or smell food that I like, it makes me want to eat” and “I feel hungry when I am with someone who is eating”. Finally, the panel reviewed all included and excluded items to ensure no further additions/removals were felt to be required. The total number of items obtained from this process was 49.

5.3.3 Piloting in a sample of adults

The extended 49-item version of the AEBQ was loaded onto Survey Monkey for piloting (Appendix 5.5). Survey Monkey is a web-based provider of survey solutions which enables the researcher to obtain secure data from participants, who are given a direct link to the previously up-loaded questionnaire (“Survey Monkey,” 2016). The aims of the pilot were to test the understanding of the questionnaire and to establish if the items and response options generated by the 49-item AEBQ made sense. The AEBQ was given to a sample of 30 adults, recruited opportunistically through personal contacts and a snowballing technique was used to increase the response rate with the aim of obtaining a minimum of 40 responses. Colleagues at University College London were asked to circulate a link to the questionnaire to their friends and family from a range of professional backgrounds. Anyone aged 18 or older could answer the questionnaire. Participants were asked to respond to each individual item and the questionnaire as a whole and give feedback on their experience of completing the AEBQ in an open answer section at the end of the questionnaire. Open-ended answers were obtained in an Excel spreadsheet from Survey Monkey. Following completion of data collection, a scoring system was developed that

calculated the most frequent comments made and which items they mapped onto, to help identify which items were problematic (Willig, 2008).

Piloting with 49 adults (21 to 73 years old), 36 women (79.6%) and 13 men (20.4%), led to the deletion of two items "Given the choice, I would always have food in my mouth" because several participants commented that it "sounded a bit odd" or was "over the top"; and a second item ("I am interested in food") was eliminated because participants reported they found the meaning ambiguous. Also, the response options 'never', 'rarely', 'sometimes', 'often' and 'always' were described by participants as unclear and were felt to not fit the questions adequately (Appendix 5.6). Response options were therefore changed from 'never', 'rarely', 'sometimes', 'often' and 'always', to 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree'. The new response options were tested with a further small convenience sample (two females and three males, aged 31 ± 7 years). This answer format appeared to be more meaningful and better understood by this sample. The remaining 47 item version of the AEBQ was used to assess its factor structure.

5.3.4 Assessing the factor structure of the AEBQ

5.3.4.1 Design and study population

Adults 18 years and over, were invited to complete a cross-sectional survey collected between the months of August and September 2013, where the AEBQ was answered via an on-line questionnaire. Participants were invited to take part by a provider of sampling and data collection for survey research called Research Now, who hold a panel of over 200,000 UK residents that have consented to answer on-line questionnaires ("Research Now," 2014). The aim was to recruit at least 500 adults (the minimum sample size for Principal Component Analysis (PCA) is $n=10$ participants for each of 47 items – see Section 5.3.4.5 below), with quotas set for 100 participants in each of the following age strata: 18 to 19 years, 20 to 24 years, 25 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years, and 60 plus years.

5.3.4.2 Measures

5.3.4.2.1 Demographic

Participants provided demographic information including ethnicity (data was collapsed into three categories: 'White' and 'Non-white' ['Black', 'Asian' or 'Mixed']) (Office for National Statistics, 2012) and 'Preferred not to answer'; education (data was collapsed into three categories for analyses: 'School' ['Primary school/Secondary school/O-level/GCSE'],

'College' ['A levels/Technical or trade certificate/Diploma'], and 'University' ['Undergraduate degree/Postgraduate degree']; employment status (was grouped as; 'employed' ['Employed full-time/ Employed part-time/Self-employed'], 'not employed' ['Unemployed/Full-time homemaker/Unpaid voluntary work/Student'] and 'disabled or retired' ['Disabled or too ill to work/Retired']); and, current living arrangement (was categorized as: 'Home owner' ['Own home outright/Own home with mortgage'], 'renting' ['Rent from local authority/Housing association/Rent privately'] or 'other' ['Living with parents/Living in University/College residential accommodation']) (Wardle, Robb, & Johnson, 2002) (Appendix 5.7).

5.3.4.2.2 Anthropometric

Participants self-reported their weight and height (Appendix 5.7). BMI was calculated used to categorise the sample into: Underweight (<18.5), normal weight (18.5 to 24.9), overweight (25.0 to 29.9) and overweight (≥ 30).

5.3.4.2.3 Appetitive traits

Participants completed the 47 item AEBQ (Appendix 5.7).

5.3.4.3 Statistical analysis

PCA was carried out using SPSS version 22.0 (IBM, 2013b). Descriptive information was based on frequency tables and cross-tabulation.

5.3.4.4 Principal component analysis

Two similar techniques are commonly used to explore the properties of newly created scales: Factor Analysis and PCA (Field, 2013). PCA is considered the simplest theoretically and the soundest mathematically to assess psychometric data (Stevens, 2009), as it transforms the data set into linear components without estimating components from unmeasured variables, and accounts for most of the variance of observed variables (Field, 2013).

In order to verify the structure of the AEBQ and to ascertain whether it was similar to the original CEBQ (Wardle, Guthrie, Sanderson, & Rapoport, 2001), PCA was therefore chosen to explore the factor structure of the AEBQ.

5.3.4.5 Sample size calculation

At least 10–15 participants per variable are commonly recommended to test the factor structure of a questionnaire (Oppenheim, 2003). However, Tinsley (1987) recommends having between five and 10 participants per variable up to a total of 300 (beyond which test parameters tend to be stable regardless of the participant to variable ratio) (Tinsley & Tinsley, 1987). Comrey and Lee (1992) class 300 as a good sample size for PCA, 100 as poor and 1000 as excellent. I therefore aimed to collect a sample size of at least 500 participants to test the 47 item questionnaire.

In order to evaluate the sampling adequacy of a data set, SPSS provides two outputs: The Kaiser-Meyer-Olkin (KMO) statistic and Bartlett's test of sphericity. The KMO statistic is used as a measure of sampling adequacy and should be greater than 0.6. Kaiser (1958) recommends accepting KMO values less than 0.5 as 'barely acceptable', values between 0.5 and 0.7 as 'mediocre', values between 0.7 and 0.8 as 'good', values between 0.8 and 0.9 as 'great' and values above 0.9 as 'superb'. Values less than 0.5 should be removed (Kaiser, 1958). Bartlett's test of sphericity, which examines whether the covariances are zero and the variances are roughly equal, should be statistically significant (Field, 2013).

5.3.4.6 Data extraction

The main aim of PCA is to reduce a large number of correlated variables to a few common components (factors) that explain the greatest proportion of variance in the data, while losing the least amount of data. This is initially achieved by calculating the common variance shared between the variables in a correlation matrix. PCA calculates all possible linear combinations of variables and extracts the component that describes the variable combinations explaining the largest amount of sample variance. This first component is called the first principal component. The subsequent components are then extracted in the same manner, and each is expressed as the variable combination explaining the greatest amount of residual variance. The amount of variance explained is known as the eigenvalue. The larger the eigenvalue, the greater the percentage of variance explained.

Following this procedure, several methods can be used to select which components should be retained. Firstly, the size of the eigenvalues is an important determinant. According to Kaiser (1958), all components with eigenvalues above one should be retained (Kaiser's criterion). Jolliffe (2002), on the other hand, suggests that Kaiser's criterion is too strict, and proposes retaining factors or components with eigenvalues greater than 0.7. Field (2013), suggests that Kaiser's criterion could be accurate when the number of items is less

than 30 and the communalities²¹ that result from the extraction are greater than 0.7 or when the sample size is greater than 250 and the average communality is greater than 0.6. Secondly, eigenvalues can be plotted on the Y-axis against the factor or component with which they are associated (X-axis), giving a graphical interpretation of eigenvalues in order of magnitude known as the scree plot. The cut-off point for selecting the number of factors or components is known as the 'point of inflection of the curve', where there is a significant change in the slope of the curve. Factors to the left of the point of inflection are retained (Field, 2013). In the present analysis, all eigenvalues >1 were retained, because the sample size was greater than 250 and the average communality was also greater than 0.6 (Field, 2013).

5.3.4.7 Rotation methods

When PCA is run, most items tend to load onto the first component. Rotation methods are then used to maximise the loadings of individual variables or items onto individual factors and equalise the importance of each component, without disrupting the underlying solutions (Field, 2013). The choice of rotation depends on the relationship that the factors are known to have with each other. The 'orthogonal' or 'Varimax' method allows the components to be uncorrelated, while the 'oblique' or 'oblimin' method allows the components to correlate (Field, 2013).

The 'oblimin' rotation method was selected because the components were expected to be correlated (Field, 2013). This results in two different sets of component matrices: (1) The 'structure matrix', which shows the correlations between each variable and factor, and; (2) The 'pattern matrix', which calculates the regression coefficient between each variable on each component, and shows the unique contribution to each component from each variable (Field, 2013). The factors were read from the pattern matrix because the regression values for each items onto each component are taken into account, stabilizing differences between measurement units and variable variances (Dugard, Todman, & Staines, 2010).

²¹ Communality is the proportion of common variance present in a variable - a variable that has no specific variance would have a communality of 1; a variable that shares none of its variance with any other variable would have a communality of 0.

5.3.4.8 Factor loadings

Factor loadings are a measure of the regression coefficients between items and they tell us about the relative contribution that a particular item makes to a component (Field, 2013). Stevens' (2009) recommends that items with factor loadings of 0.40 or above are retained for samples greater than 200 participants. A factor loading value greater than 0.40 explains 16% of the variance. However, a value of 0.30 can also be used given the large sample size collected in this study (Field, 2013). Items with factor loadings greater than 0.30 were therefore retained because these are considered statistically meaningful with a large sample size (Field, 2013).

SPSS allows for a set number of factors to be introduced in the analysis, if an underlying theory exists. In this case however, no set number of factors was introduced in the analysis in order to observe whether the same structure as the CEBQ emerged for the AEBQ. The data presented only shows factor loadings above 0.30 (Table 5.3).

5.3.4.9 Missing data

There were no missing data, given participants were forced to respond to each item through the design of the Survey Monkey questionnaire (i.e. all questions had to be completed in the on-line response form, otherwise the participant could not click through to the next page of questions).

5.3.4.10 Assumptions

PCA makes a number of assumptions (Field, 2013), and these were all tested:

- (1) The sample size should be adequate. A sample size of $n=708$ was suitable according to the parameters discussed in section 5.3.4.1 above.
- (2) All variables must show high inter-correlation. Any variables that correlate with no others should be eliminated, as they do not contribute to the factor structure and any variables that are perfectly correlated (1.0) should be eliminated (Comrey & Lee, 1992). There should be several correlation coefficients greater than 0.3 in the correlation matrix.
- (3) Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy should be greater than 0.6 and Bartlett's test of sphericity should be significant.
- (4) Correlations should be linear.

(5) The model should fit the data well. Having less than 50% of the residuals above 0.05 represents a good model fit.

(6) Variables should be normally distributed. This assumption of normality is used to allow generalisation of the results beyond the sample collected.

5.3.4.11 Criteria used for eliminating items

Once the PCA was run, a number of criteria were considered to eliminate items from the questionnaire. The pattern matrix output revealed an initial ten-factor structure with eigenvalues greater than one. The criteria used to eliminate the items from the questionnaire were discussed with a group of experts on eating behaviour, as well as the original authors from the CEBQ. An iterative process was used to gradually remove items that were represented by unacceptable factor loadings of less than 0.30 (Field, 2013), items that loaded onto several components, or items that were found to contribute poorly to the model fit.

5.3.5 Summary statistics

Skewness and kurtosis statistics were calculated for each individual item (not shown in the results), to test for assumptions for each obtained scale score to check for normality. Items falling within the range of 1 and -1 for skewness and kurtosis were considered normal. Correlations between scales were determined using Pearson's Product Moment correlation coefficients for normally distributed scales and Spearman's Rho for non-normally distributed scales. A Pearson's correlation of ± 0.1 represents a small effect, ± 0.3 a medium effect and ± 0.5 a large effect (Field, 2013).

5.3.6 Internal reliability

The internal reliabilities of the components derived from the PCA were assessed using Cronbach's alpha (Cronbach, 1951). Internal reliability describes the extent to which all the items in a questionnaire measure the same concept or construct and hence it is connected to the interrelatedness of the items within the test (Tavakol & Dennick, 2011). A Cronbach's alpha of 0.70 or greater was considered acceptable (Field, 2013).

5.4 Ethical approval

This study was part of the project 'ID number 4378/001: "Validation of the AEBQ" for which ethical approval was obtained from the UCL Research Ethics Committee (Appendix 5.8).

5.5 Results

The 47-item questionnaire was completed by 49 adults aged 21-73 years (mean age 38.2 ± 14.6), of whom 36 were women (79.6%) and 13 were men (20.4%).

5.5.1 Assessment of the factor structure

5.5.1.1 Characteristics of the sample

The 47 item AEBQ was then completed by 708 participants via the on-line questionnaire. The participants ranged in age from 18 to 81 years (mean age 38.7±17.0). Approximately half were men (336; 47.5%) and the mean BMI was 26.1±5.8. Most were of white ethnicity (635; 89.7%). One-third of the sample had completed higher education (196/; 31.9%) (Table 5.1).

Table 5.1 Characteristics of the sample used to carry out PCA of the 47-item AEBQ (n=708)

Characteristic	n (%)
Age	
18 to 29	301 (42.5%)
30 to 59	300 (42.4%)
60 +	107 (15.1%)
Gender	
M	336 (47.5%)
F	372 (52.5%)
BMI*	n=674
Underweight	30 (4.4%)
Normal weight	328 (48.7%)
Overweight	173 (25.6%)
Obese	143 (21.2%)
Ethnicity	
White	635 (89.7%)
Non-white	68 (9.6%)
Preferred not to answer	5 (0.7%)
Education	n=700
School	179 (25.6%)
College	242 (34.6%)
University	279 (39.9%)

*674 (95.2% of the sample) participants had a BMI range of 15.34 to 49.87. Participants who reported a BMI <14 or >50 were excluded as these values were felt to be unrealistic.

5.5.1.2 Testing for assumptions

With 47 variables resulting from the AEBQ, having 10 participants per variable would give a sample of 470, well above the threshold of 300 required for a sufficiently stable analysis (Field, 2013). Therefore, the sample size of $n=708$ was considered adequate.

All individual items on the 47-item AEBQ fell within the range of 1 and -1 for skewness and kurtosis and were normally distributed. There was a majority of inter-correlations above 0.3 between the items, with no multi-collinearity.

The KMO measure of sampling adequacy was 0.878 which is classified as 'great' (Hutchenson & Sofroniou, 1999), and Bartlett's test of sphericity was statistically significant with $\chi^2 (595)=12558.321, p<0.0001$. No absolute residual values were above 0.05, indicating that the model fits the data well. The retained eigenvalues were all greater than one and the communalities ranged from 0.6 to 0.8, satisfying Kaiser's criterion.

All assumptions outlined in the methods were met (Section 5.3.4.10).

5.5.2 Criteria used for eliminating items

PCA was run on the 47 item AEBQ (Appendix 5.7), and the criteria used for the removal of items after each PCA run is shown in Table 5.2.

Table 5.2 Criteria used for the removal of items in the AEBQ factor analysis

Items in order of removal	Number of factors remaining after PCA	Reasons for the removal of items
Q29 "I eat less when I am tired" Q12 "I eat more when I am tired"	9 components	Q29 and Q12 loaded on a single factor, which did not make theoretical sense
Q27 "I eat less when I'm bored" Q32 "I eat less when I have nothing else to do"	8 components	Q27 and Q32 also loaded alone on a single factor (as above).
Q15 "I eat more when I'm bored" Q45 "I eat more when I have nothing else to do"	8 components	Q15 and Q45 loaded together with three 'food responsiveness' items (Q25 "If I allowed myself, I would eat too much", Q18 "Even if I am full up I find room to eat my favourite food" and Q44 "When I see or, smell food that I like, it makes me want to eat") and a 'satiety responsiveness' item (Q40 "I cannot eat a meal if I have had a snack just before") onto one factor, therefore conceptually this was an issue.
Q43 "I have a big appetite"	8 components	Q43 loaded onto the same factor as 'food responsiveness' and 'hunger' items.
Q6 "I eat less when I'm happy" and Q38 "I eat more when I'm happy"	8 components	Q6 "I eat less when I'm happy" was removed as it loaded onto the 'emotional over-eating' construct. Q38 "I eat more when I'm happy" was removed as it loaded onto the 'emotional under-eating' construct.
Q25 "If I allowed myself I would eat too much"		Q25 was considered an item that related more to 'restraint' than to 'food responsiveness', where it loaded.
Q20 "I am difficult to please with meals"	7 components	Q20 was removed as an individual could be considered to be difficult to please not only with meals but with many other things as well, even though it loaded onto the 'food fussiness' construct.
Q18 "Even if I am full up I find room to eat my favourite food"	7 components	Q18 loaded onto both 'satiety responsiveness' and 'food responsiveness' with the lowest factor loading

A final re-run of the PCA was carried out, identifying a 35-item questionnaire. Factor loadings for each item were obtained after 'oblimin' rotation and seven components were

retained (Table 5.3). The items that clustered onto the same factors corresponded to similar CEBQ scales and were: Component 1 clustered the newly added 'hunger' (H) items and 'food responsiveness' (FR) items, which loaded onto a single component ['hunger and food responsiveness' (HFR)]; Component 2 clustered 'satiety responsiveness' (SR) items; Component 3 clustered 'emotional under-eating' (EUE) items; Component 4 clustered 'food fussiness' (FF) items; Component 5 clustered 'emotional over-eating' (EOE) items; Component 6 clustered 'enjoyment of food' (EF) items; and Component 7 clustered 'slowness in eating' (SE) items. All of the individual items had factor loadings above 0.4, except for "When I see or smell food that I like, it makes me want to eat", with a factor loading of 0.355 on component 1. The item was still retained, because it added to the meaning of the construct, and is considered statistically meaningful with a large sample size (Field, 2013). The item, "I often feel hungry when I am with someone who is eating" was also retained although it loaded onto both component 1 (0.401) and component 6 (0.307); it was retained as part of component 1 due to its higher factor loading on this component. A comparison of the items in this final version of the AEBQ and those in the original CEBQ items is shown in Appendix 5.9. The thirty-five items had an average communality of 0.642 and seven factors explained 64.3% of the variance in the items.

The final 35-item AEBQ with its scoring system can be seen in Appendix 5.10.

Table 5.3 Factor loadings of a 35-item AEBQ

	Components determined through PCA ^a							
	Eigenvalue (% variance explained)	1 H + FR	2 SR	3 EUE	4 FF	5 EOE	6 EF	7 SE
Q26-I often notice my stomach rumbling	6.638 (19%)	0.752						
Q37-I often feel so hungry that I have to eat something right away		0.737						
Q42-I often feel hungry		0.69						
Q46-If my meals are delayed I get light-headed		0.66						
Q9-If I miss a meal I get irritable		0.545						
Q30-I am always thinking about food		0.56						
Q21-Given the choice, I would eat most of the time		0.477						
Q14-I often feel hungry when I am with someone who is eating		0.401					0.307	
Q44-When I see or smell food that I like, it makes me want to eat		0.355						
Q41-I get full up easily	5.301 (15.2%)		0.778					
Q40-I cannot eat a meal if I have had a snack just before			0.753					
Q11-I often leave food on my plate at the end of a meal			0.612					
Q31-I often get full before my meal is finished			0.611					
Q36-I eat less when I'm annoyed	3.264 (9.3%)			0.836				
Q17-I eat less when I'm worried				0.835				
Q47-I eat less when I'm anxious				0.827				

Q24-I eat less when I'm upset		0.825	
Q22-I eat less when I'm angry		0.756	
Q7-I refuse new foods at first			-0.826
Q23-I am interested in tasting new food I haven't tasted before*			0.815
Q2-I often decide that I don't like a food, before tasting it	2.868 (8.2%)		-0.791
Q13-I enjoy tasting new foods*			0.787
Q33-I enjoy a wide variety of foods*			0.692
Q10-I eat more when I'm upset			-0.871
Q8-I eat more when I'm worried	1.829		-0.86
Q19-I eat more when I'm anxious	(5.2%)		-0.83
Q4-I eat more when I'm annoyed			-0.814
Q28-I eat more when I'm angry			-0.717
Q3-I enjoy eating	1.368		0.854
Q1-I love food	(3.9%)		0.831
Q5-I look forward to mealtimes			0.814
Q39-I eat slowly			-0.899
Q34-I am often last at finishing a meal	1.206		-0.869
Q16-I often finish my meals quickly*	(3.5%)		0.775
Q35-I eat more and more slowly during the course of a meal			-0.672

*Items were reverse scored when calculating scale means and Cronbach's alphas.

^a Factor loadings above 0.3 are presented; H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'; SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'.

5.5.3 Summary statistics

Descriptive statistics are shown in Table 5.4 for each component (now referred to as appetitive traits). Although the 'hunger' and 'food responsiveness' items loaded onto the same component, they were treated as two separate constructs, because they are considered to be distinct from a theoretical basis (Schachter, 1968; Stunkard & Messick, 1985). The data for all of the scales were normally distributed, with the exception of 'enjoyment of food'. Appetitive traits can be grouped into 'food approach' scales, which include 'hunger', 'food responsiveness', 'emotional over-eating' and 'enjoyment of food' and 'food avoidance' scales, which include 'satiety responsiveness', 'emotional under-eating', 'food fussiness' and 'slowness in eating'.

Table 5.4 Descriptive statistics of appetitive traits in the 35-item AEBQ (n=708)

	Food approach scales				Food avoidance scales			
	Hunger	Food responsive- ness	Emotional over- eating	Enjoyment of food	Satiety responsiveness	Emotional under-eating	Food fussiness	Slowness in eating
Mean	3.02	3.07	2.74	3.96	2.71	2.96	2.35	2.68
Median	3.00	3.00	2.80	4.00	2.75	3.00	2.40	2.75
SD	0.75	0.78	0.88	0.74	0.79	0.85	0.79	0.87
Skewness	-0.10	0.03	0.17	-0.71	0.35	-0.03	0.40	0.25
Kurtosis	-0.12	-0.05	-0.23	0.89	0.08	0.01	-0.06	-0.34

SD = standard deviation

Correlations between the appetitive traits are shown in Table 5.5. All correlations are in the direction that was expected, with the 'food approach' traits correlating positively with other 'food approach' traits and negatively with the 'food avoidance' traits. Similarly, 'food avoidance' traits correlated positively with one another.

Table 5.5 Correlations between appetitive traits (n=708)

		Food approach traits			Food avoidance traits			
		Food responsiveness	Emotional over-eating	Enjoyment of food	Satiety responsiveness	Emotional under-eating	Food fussiness	Slowness in eating
Food approach traits	Hunger	0.64**	0.39**	0.33**	0.07	0.22**	0.01	-0.03
	Food responsiveness	-	0.49**	0.51**	-0.16**	0.10**	0.06	-0.09*
	Emotional over-eating		-	0.21**	0.01	-0.09*	-0.01	0.02
	Enjoyment of food			-	-0.29**	-0.07*	-0.34**	-0.16**
Food avoidance traits	Satiety responsiveness				-	0.37**	0.22**	0.43**
	Emotional under-eating					-	0.12*	0.12**
	Food fussiness						-	0.11**

^a Pearson's correlation was used for normally distributed mean scores, except for 'enjoyment of food' where Spearman's rho was used.

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

* Correlation is significant at the 0.05 level (2-tailed)

5.5.4 Reliability

Cronbach's alphas for each appetitive trait were all above 0.7 (α range = 0.762 to 0.881), indicating that the scales have good internal reliability (Table 5.6). Results show that the elimination of any one item did not increase the reliability of any trait, with the exception of the 'slowness in eating' scale ($\alpha=0.842$). Here, the Cronbach's alpha increased following elimination of item Q16 "I often finish my meals quickly" (α increased to 0.846) and item Q35 "I eat more and more slowly during the course of a meal" (α increased to 0.846). However, both items were retained, as the Cronbach's alpha value for the scale was still high with the retention of both these items ($\alpha = 0.842$) (Table 5.6).

Table 5.6 Internal reliability of appetitive trait scales for the AEBQ

AEBQ trait	AEBQ Items	Cronbach's alpha	Cronbach's alpha - If individual items were eliminated
H	Q26-I often notice my stomach rumbling	0.762	0.751
	Q37-I often feel so hungry that I have to eat something right away		0.686
	Q42-I often feel hungry		0.705
	Q46-If my meals are delayed I get light-headed		0.719
	Q9-If I miss a meal I get irritable		0.732
FR	Q30-I am always thinking about food	0.766	0.687
	Q21-Given the choice, I would eat most of the time		0.666
	Q14-I often feel hungry when I am with someone who is eating		0.723
	Q44-When I see or smell food that I like, it makes me want to eat		0.754
EOE	Q10-I eat more when I'm upset	0.877	0.837
	Q8-I eat more when I'm worried		0.846
	Q19-I eat more when I'm anxious		0.845
	Q4-I eat more when I'm annoyed		0.851
	Q28-I eat more when I'm angry		0.87
EF	Q3-I enjoy eating	0.859	0.767
	Q1-I love food		0.782
	Q5-I look forward to mealtimes		0.855
SR	Q41-I get full up easily	0.765	0.644
	Q40-I cannot eat a meal if I have had a snack just before		0.73
	Q11-I often leave food on my plate at the end of a meal		0.73
	Q31-I often get full before my meal is finished		0.727
EUE	Q36-I eat less when I'm annoyed	0.881	0.855
	Q17-I eat less when I'm worried		0.846
	Q47-I eat less when I'm anxious		0.85
	Q24-I eat less when I'm upset		0.848
	Q22-I eat less when I'm angry		0.876
FF	Q7-I refuse new foods at first	0.852	0.815
	Q23-I am interested in tasting new food I haven't tasted before*		0.807
	Q2-I often decide that I don't like a food, before tasting it		0.844
	Q13-I enjoy tasting new foods*		0.812
	Q33-I enjoy a wide variety of foods*		0.831
SE	Q39-I eat slowly	0.842	0.738
	Q34-I am often last at finishing a meal		0.752
	Q16-I often finish my meals quickly		0.846
	Q35-I eat more and more slowly during the course of a meal		0.846

* Items were reversed scored when calculating scale means and Cronbach's alphas.

H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'; SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'

5.6 Discussion

This chapter describes the successful development of a new self-report version of the CEBQ for adults; the AEBQ. The AEBQ has 35 items, loading onto seven scales broadly equivalent to the CEBQ, which capture four 'food approach' traits and three 'food avoidance' traits. The 'food approach' traits are: 'hunger' which loaded onto the same component as 'food responsiveness', 'emotional over-eating', and 'enjoyment of food'. The 'food avoidance' traits are: 'satiety responsiveness', 'emotional under-eating', 'food fussiness' and 'slowness in eating'. The AEBQ differs from the CEBQ in that responses are in an agree/disagree format to suit self-reporting, an additional 'hunger' scale is captured, and the 'desire to drink' scale has been removed. The questions in the AEBQ are appropriate for adults in a self-report format. The AEBQ shows high internal reliability, and should be useful to assess dimensions of adult appetite that are not captured by existing questionnaires.

5.6.1 Factor structure

The new items on 'hunger' and 'food responsiveness' that were added to the AEBQ provide additional information on appetitive traits that could only be obtained through self-report. The AEBQ measures some overlapping qualities between these constructs, which would explain why items load onto the same component. However, these scales were kept as separate theoretical and empirical entities (as described in section 5.5.3), because there appears to be enough literature to support distinguishing them as separate dimensions of eating, i.e. 'hunger' (Stunkard & Messick, 1985) and 'externality' (Schachter, 1968). It is worth noting however, that the 'food responsiveness' items have the lowest factor loadings, explaining a smaller percentage of the variance than the 'hunger' items.

The 'desire to drink' construct was eliminated from the AEBQ, as it did not make conceptual sense for adults and 'drink' could be misinterpreted as meaning 'alcohol' by adult samples. The desire for soft drinks or sugar-sweetened beverages (SSBs), which has been associated with weight gain in children and adolescents (Piernas, Barquera, & Popkin, 2014), had previously been added to a self-report version of the CEBQ in a sample of 13 year old Malaysian adolescents (Loh et al., 2013). However, no association between 'desire to drink' (with items such as "I always want soft drinks") and weight in this age group was observed (Loh et al., 2013). These results could be due to the fact that associations with consumption of SSBs and BMI or fatness have not always been consistent (Johnson,

Mander, Jones, Emmett, & Jebb, 2007; Sweetman, Wardle, & Cooke, 2008). Evidence for an association between the CEBQ 'desire to drink' scale and BMI in children is conflicting, with some studies showing no association (Powers, Chamberlin, van Schaick, Sherman, & Whitaker, 2006; Santos et al., 2011; Sleddens et al., 2008; Sweetman et al., 2008; Viana et al., 2008) and others showing positive associations (Crocker et al., 2011; Rodenburg et al., 2012; Soussignan et al., 2012). Due to the overall balance of null associations with BMI, and the lack of relevance for adults 'desire to drink' was not considered an appropriate scale to include in the AEBQ. The lack of its inclusion should not diminish the predictive capability of the AEBQ to assess appetitive traits that are salient for weight management.

Comparison of the traits assessed in the CEBQ versus the AEBQ indicates that appetitive traits, although stable, may have different relationships with weight across the life course. In the CEBQ, items representing 'satiety responsiveness' and 'slowness in eating' load onto a single construct, although they are considered to be separate theoretical entities (Wardle, Guthrie, Sanderson, & Rapoport, 2001). By contrast, in the AEBQ, 'satiety responsiveness' and 'slowness in eating' did load onto two separate factors, implying they are not so closely associated in adults. However, the newly created 'hunger' items and 'food responsiveness' items did load onto a single component in the AEBQ. A similar relationship was observed in the TFEQ-R18 (de Lauzon et al., 2004), where 'hunger' items were closely related to the 'uncontrolled eating' factor, which although different, is somewhat comparable to 'food responsiveness' as it relates to a disinhibited tendency to eat opportunistically, such as eating in the presence of others eating, and being responsive to the palatability of food and eating in response to negative mood (Polivy et al., 1979).

5.6.2 Correlations between sub-scales

Positive correlations were observed between individual constructs within each of the 'food approach' ('hunger', 'food responsiveness', 'emotional over-eating' and 'enjoyment of food') and 'food avoidance' ('satiety responsiveness', 'slowness in eating', 'food fussiness' and 'emotional under-eating') trait dimensions. Negative correlations were observed between the two dimensions, suggesting that each dimensions measures a different set of traits. These results are consistent with those previously shown in the CEBQ and BEBQ (Llewellyn, van Jaarsveld, et al., 2011; Wardle, Guthrie, et al., 2001), and highlight the validity of the measure.

5.6.3 Limitations

A limitation of this study relates to the selection of piloting methods used. To improve face (content) validity of the study, adaptation of the AEBQ may have benefited from structured cognitive testing (Banna, Vera Becerra, Kaiser, & Townsend, 2010). A more qualitative approach such as 'Think-Aloud' interviews could have been used as an efficient method to gain insight into participants' understanding of questionnaire items (Fox, Ericsson, & Best, 2011). It is possible that this would have led to wordings different from those selected for use in the final AEBQ. Also, data collection through a survey sampling company tends to draw demographically homogeneous people to answer the questionnaire, not allowing for significant ethnic or social differences to be observed from the sample; even though a good mix of educational levels were represented, the sample was predominantly white. Given that the data collection was on-line, input from those without internet access was not possible. This also results in a lack of information available about the number of questionnaire invitations that were sent and the number of people opting out. A study with data collection on appetite might also encourage those with an interest in eating and weight management to participate in the study.

Although the results show the AEBQ to be a reliable measure of seven clear constructs of appetite (and eight theoretical dimensions), the way in which items were selected for elimination has its limitations. For example, before reducing the number of items because of their conceptual overlap, items could have been removed from a quantitative standpoint according to the effect of their deletion on the Cronbach's alphas. However, the method I used, with the help of a panel of experts on eating behaviour, allowed for the 'food responsiveness' construct to be retained. This dimension of appetite is positively associated with weight in children (Carnell & Wardle, 2008a; Sleddens et al., 2008; Viana et al., 2008) and infants (Llewellyn, van Jaarsveld, et al., 2011), underscoring its potential relevance for predicting weight in adults, independently from the effects of 'restraint'. Although a systematic way to improve the psychometric value of the questionnaire was carried out, the removal of different items will always affect factor loadings and measures of reliability (Field, 2013).

Although the AEBQ appears to be a reliable measure of appetitive traits in adults, questionnaires should also be validated, preferably against experimental measures (See Section 2.4.1, Chapter 2). Experimental measures serve as indicators of psychometrically defined dimensions and ensure the questionnaire is measuring what it should be measuring

(Allison & Baskin, 2009; Carnell & Wardle, 2007). The CEBQ was validated in an experimental setting to demonstrate EAH as a lack of 'satiety responsiveness' and a measure of a higher degree of 'food responsiveness' and 'enjoyment of food' (Carnell & Wardle, 2007). Other ways of validating questionnaires is to apply previously validated questionnaires and assess their convergence with the measure in question (Cepeda-Benito et al., 2000; Krall & Lohse, 2011; van Strein, Herman, Engels, Larsen, & van Leeuwe, 2007). Confirmation of the factor structure using Confirmatory Factor Analysis (CFA) can also serve as a form of construct validity and will be the purpose of Study 3 in Chapter 6.

Conclusions drawn from PCA are necessarily restricted to the specific sample from which they arise (Field, 2013; Thompson, 1951). Therefore, replication of the component structure in different groups of adults should be obtained (Streiner & Norman, 2015). Reliability of a scale can also vary according to the sample used, therefore it becomes important to repeat the analysis with other samples (Field, 2013). Thus, the objective of Study 3 in Chapter 6 will be to replicate the component structure of the AEBQ in a validation sample, to provide evidence for the validity of the AEBQ and to provide further evidence of its reliability.

5.6.4 Conclusions

The findings from this study demonstrates the underlying structure of the AEBQ, a self-report measure of appetitive traits in adults, and confirms its internal reliability. The appetitive traits identified are mostly the same as in children, but with the addition of 'hunger', which becomes measurable in a self-report format, and without 'desire to drink', which is difficult to interpret for adults. The AEBQ therefore provides a comprehensive, convenient, and easy-to-use measure of adult appetitive traits. The AEBQ could allow large-scale research into those appetitive traits currently not covered by existing adult measures, but which are strongly related to weight in infant and child populations, and improve the understanding of the contribution of these traits to weight gain in adulthood. The following chapter will confirm the structure of the AEBQ in a second sample of adults and assess the associations between the appetitive traits captured by the AEBQ and weight.

Chapter 6. Study 3: Confirmation of the factor structure of the 'Adult Eating Behaviour Questionnaire'²²

6.1 Background

Study 2 in Chapter 5 used PCA on 47 items developed from the CEBQ (Wardle, Guthrie, Sanderson, & Rapoport, 2001) in a sample of 708 adults to develop a 35-item AEBQ, which encompasses three 'food approach' scales and four 'food avoidance' scales. The 'food approach' scales assess 'hunger and food responsiveness' (nine items), 'emotional over-eating' (five items), and 'enjoyment of food' (three items). The four 'food avoidance' scales assess 'satiety responsiveness' (four items), 'emotional under-eating' (five items), 'food fussiness' (five items), and 'slowness in eating' (four items).

Having demonstrated that the AEBQ is a reliable instrument, it is important to test the questionnaire in a different sample to ensure reproducibility and to test for construct validity (Cole, 1987; Field, 2013). Confirmatory Factor Analysis (CFA) is a method for testing the construct validity of a questionnaire developed through PCA (Thompson, 1951). CFA tests the hypothesis that exists between the constructs obtained from PCA, and tests any previous relationships which exist between the items. Also, given that the reliability of a scale can vary according to the sample used, it is imperative to repeat the analysis with other samples to ensure reproducibility (Field, 2013; Streiner & Norman, 2015).

In addition, it is important to explore associations between the appetitive traits measured by the AEBQ and weight. As discussed in Chapter 2, Section 2.5.2, individual differences in appetite are thought to help explain variation in weight across the population (Carnell & Wardle, 2008a; Wardle, 2007), as described by the "Behavioural Susceptibility Theory"

²² A version of this chapter has been accepted for publication: Hunot, C., Fildes, A., Croker, H., Llewellyn, C. H., Wardle, J., & Beeken, R. J. (2016). Appetitive traits and relationships with BMI in adults: Development of the Adult Eating Behaviour Questionnaire. *Appetite*. <http://dx.doi.org/10.1016/j.appet.2016.05.024>. A copy of this paper is presented in Appendix 5.1.

A version of this chapter was also presented at conferences (Appendix 5.2).

(BST) of obesity (Llewellyn & Wardle, 2015). A large number of studies in children have shown that appetitive traits, as measured by the CEBQ, are associated with weight across a range of geographic locations, cultures, and ethnic groups. 'Food approach' scales have been consistently positively associated with weight (Carnell & Wardle, 2008a; Santos et al., 2011; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009), while 'food avoidance' scales have been negatively associated with weight (Carnell & Wardle, 2008a; Santos et al., 2011; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009). Whether the relationship between these appetitive traits and weight holds into adulthood is unknown. The primary reason for developing the AEBQ was to enable exploration of these relationships within adult samples.

6.2 Aim and hypothesis

The main aims of this study were to confirm the factor structure of the AEBQ in a new sample of adults and to investigate the associations between appetitive traits measured by the AEBQ and BMI. The study also aimed to test the reliability of the questionnaire in this sample (internal and test-retest). Two hypotheses were tested: (1) that the structure of the AEBQ would remain the same as that obtained from the PCA in the previous Study 2; and (2) the relationships between appetitive traits and BMI would be similar to those found in children using the CEBQ, i.e. that 'food approach' traits such as 'hunger, 'food responsiveness', 'emotional over-eating' and 'enjoyment of food', would be positively associated with BMI; and, 'food avoidance' traits such as 'satiety responsiveness', 'emotional under-eating', 'food fussiness' and 'slowness in eating' would be negatively associated with BMI.

6.3 Methods

6.3.1 Design and study population

Following a similar method to Study 2, Chapter 5, Section 5.3.4.1 (Sample 1), a second cross-sectional survey was conducted in November 2014 (Sample 2). Adults aged 18 years and over, who were members of an on-line survey panel (Research Now) were invited to take part in the study, through a Survey Monkey link. By responding to the questionnaire, participants consented to their participation in the study (Appendix 6.1).

6.3.1.1 Sample size calculations

Quotas for the data collection were set to ensure the sample matched the general population with respect to the proportion of overweight and obese participants. Based on the Health Survey for England 2013 (Health and Social Care Information Centre, 2014), targets were set for 41% overweight and 24% obese men, and 33% overweight and 26% obese women. The planned sample size was n=1000 participants and results from Study 2 (Sample 1), were used to calculate age quotas in order to obtain a representative sample of overweight and obese participants similar to English obesity trends. The aim was to recruit approximately, 200 (20%) 20 to 29 year olds; 200 (20%) 30 to 39 year olds; 250 (25%) 40 to 49 year olds; 250 (25%) 50 to 59 year olds; and 100 (10%) 60+ year olds. This would result in approximately 100, 80, 100, 100 and 35 overweight or obese participants respectively per age group.

Questionnaires were checked individually for the time it took to complete them. On average, participants spent 20 to 25 minutes answering the questionnaire. As a quality control measure, all participants who took less than 14 minutes to complete the questionnaire were excluded, as this would not have allowed sufficient time for participants to read and respond to the questionnaire with full comprehension after testing the fastest answering time in different individuals. Forty-three questionnaires were removed due to acquiescence and extreme responses in greater than 50% of the replied questionnaires (Allison & Baskin, 2009), and 17 participants did not complete the questionnaire (43 + 17 = 60 questionnaires removed). The majority of the participants who were eliminated were men and women under age 30 years and men under age 40 years old. Thus, a final sample with 954 participants was obtained (94% of those who began the on-line questionnaire).

6.3.2 Measures

6.3.2.1 Demographic

Participants provided the same demographic information as for Study 2 (Chapter 5, Section 5.3.4.2). Briefly: ethnicity ('White' and 'Non-white'); education ('School', 'College' and 'University'); employment status ('Employed', 'not employed', and 'disabled or retired'); current living arrangement ('Home owner', 'renting', 'other'). They were additionally asked about their marital status ('Single', 'Co-habiting' [married, living as married], and 'other' [separated, divorced, widowed]) (Appendix 6.1).

6.3.2.2 Anthropometric

Participants self-reported height and weight and BMI was calculated and used to categorise weight status (Appendix 6.1). BMI was categorised into: Underweight (<18.5), normal weight (18.5 to 24.9), overweight (25.0 to 29.9) and obese (≥ 30).

6.3.2.3 Appetitive traits

Participants completed the 35-item AEBQ (Sample 2), which was developed in Study 2, Chapter 5 (Appendix 6.1).

6.3.3 Statistical analysis

Sociodemographic variables for the sample in Study 2 (Chapter 5, Section 5.3.4.2, whom I will refer to as Sample 1), and the sample in this study (whom I will refer to as Sample 2) were compared using Chi-squared tests for categorical variables. Means and standard deviations were calculated for each of the AEBQ scales for Sample 2, and correlations between scales were determined using Pearson's Product Moment correlation coefficients for normally distributed scales and Spearman's Rho for non-normally distributed scales. All statistical analysis was performed using IBM SPSS Statistics version 22.0 (IBM, 2013b).

6.3.3.1 Confirmatory factor analysis

All analyses were performed using SPSS AMOS version 22.0 (IBM, 2013a). The 35 AEBQ items²³ were entered into a seven factor CFA²⁴ ('hunger and food responsiveness' which loaded onto the same component in the PCA, 'emotional over-eating', 'enjoyment of food', 'satiety responsiveness', 'food fussiness' and 'slowness in eating'). The indicators were loaded onto the *a priori*-determined corresponding factors, based on the results from the PCA of the AEBQ in Study 2 in Chapter 5.

²³ In CFA, items are termed indicators, which I will continue to use throughout this chapter, except in the discussion.

²⁴ In CFA, the term factor corresponds to PCA components. Factors are also known as latent variables. So the components obtained from PCA will now be referred to as factors.

6.3.3.2 Input diagrams

CFA produces an input diagram (output), where single-headed arrows connect the hypothesised factors (represented by ovals) and the measured indicators (represented by rectangles). The regression coefficients (β - values) are shown above the arrows. Since each measured indicator has residual variance not explained by the latent factor, each indicator is associated with a residual (represented by the smaller circles containing an 'e'). The curved two-headed arrows indicate covariance between two factors. In general, measurement errors between the indicators are assumed to be uncorrelated, but factors are allowed to correlate between each other (Dugard et al., 2010).

The CFA model must be identified, where the 'just-model' represents the model where the number of data points equals the number of parameters that must be estimated. The number of parameters that can be calculated while maintaining an identifiable model is $k(k+1)/2$, where k =observed variables. In this study, the number of observed variables was 35, therefore the number of identifiable parameters for this sample was $35(35 +1)/2=630$. Given that the model requires 77 parameters to be estimated (35 β - values, 35 residuals and 7 covariances), this model is therefore over-identified (i.e. it contains fewer parameters than data points and can therefore be used to test a given theory), resulting in $630-77=553$ degrees of freedom, when the model fit is tested (Dugard et al., 2010).

6.3.3.3 Model fit statistics

In order to show whether the proposed model fits the data, correlations between the variables must be correctly accounted for (Dugard et al., 2010). It is recommended to consult several fit statistics when running CFA, to assess whether they are consistent (Thompson, 1951). The normed fit index (NFI) indicates the degree to which the defined model improves fit over the null model; for example, a NFI of 0.90 means the defined model improves the fit by 90% relative to the null model (Hu & Bentler, 1999). A comparative fit index (CFI) of 0.90 to 0.95 suggests a good model fit, as does a Root-Mean-Square Error Approximation (RMSEA) ≥ 0.06 (Hu & Bentler, 1999; Thompson, 1951). The Chi-square test is a measure of the difference between observed and expected covariance matrices and should be non-significant. However, the Chi-square test readily reaches significance with large sample sizes even when all other indices indicate a good fit (Dugard et al, 2010). As in PCA, factor loadings, which tell us about the relative contribution that a particular item makes to a factor (Field, 2013), should be greater than 0.40 (Stevens, 2009) (Section 5.3.4.8). Out of several competing models, the model with the lowest AIC

(Akaike's Information Criteria) and BIC (Bayesian Information Criterion) values is considered the best fit to the data (Dugard et al., 2010; Field, 2013). All these model fit statistics are presented in the results, however, the AIC and BIC were used as model selection criteria in this study. Given the AIC is a model statistic which penalizes a model for having a greater amount of variables by giving it a higher score, the lowest values for AIC was used to represent the best model fit (Field, 2013).

6.3.3.4 Post-hoc modifications to the model

If the initial output from the CFA does not result in a good model fit, SPSS AMOS provides two useful diagnostic statistics: (1) standardised residuals, and (2) modification indices. High standardised residual values for the covariance between two variables, point towards the relationship between these variables not being well accounted for by the model. A high modification index, indicated by a high value of the parameter change between variables in the model, is an indication that co-varying the error terms or residuals between these variables (part of the same factor) should improve the model fit (Dugard et al., 2010). Generally, error terms should not be co-varied with observed or latent variables, or with other error terms that are not part of the same factor. Thus, the most appropriate modification available is to co-vary error terms that are part of the same factor (Gaskin, 2016).

6.3.3.5 Reliability

Cronbach's alpha was used to test internal reliability for each appetitive trait, with a value greater than 0.70 indicating good reliability (Field, 2013). A sub-sample of respondents from Sample 2, completed the AEBQ again two weeks later to assess test-retest reliability. Test-retest reliability was assessed using intra-class correlation coefficients (ICC) (McGraw & Fleiss, 1996) using Cronbach's alpha model based on the average inter-item correlation (i.e. every split-half reliability), with results presented as an average measure of the two correlation scores. Again, values greater than 0.70 indicate good reliability. This method is considered the best to test test-retest reliability and has been used in the development and validation of many questionnaires (Bartle, Hill, Webber, van Jaarsveld, & Wardle, 2013; Carnell & Wardle, 2007; Loh et al., 2013; Tanofsky-Kraff et al., 2007).

6.3.3.6 Relationships with BMI

Correlations between appetitive traits and BMI were determined using Pearson's correlation coefficient for normally distributed scales and Spearman's rho for the non-

normally distributed scales ('enjoyment of food'). The linear associations between appetitive traits (predictor variables) and BMI (outcome variable) were estimated using linear regression analysis in Sample 2 with realistic BMI's (>14 and <50). The obtained β -values represent the slope of the regression line, whereby the greater the slope, the stronger the relationship between the predictor and the outcome variable (Field, 2013). The R^2 value indicates the proportion of the variance in the outcome variable that is explained by the model (Field, 2013). The model was adjusted for age and gender. Respondents with plausible BMI values (>14 and <50) were included in the model (n=940).

The results were checked so that all the assumptions for linear regression analyses were met:

- (1) Linearity of the relationships between the predictor and outcome variables. This was assessed visually using scatterplots.
- (2) Independence of the errors (residuals). This was assessed using the Durbin-Watson test. Values >2 indicate a negative correlation between adjacent residuals, and a positive correlation when <2. Values <1 or >3 are considered problematic (Field, 2013).
- (3) Homogeneity of variance (homoscedasticity). This was assessed visually using a scatterplot.
- (4) Normality of the errors (residuals). This was assessed using a normality plot of the residuals.
- (5) Multicollinearity of the predictors. No predictor variables should correlate too highly with one another, e.g. above 0.95 (Field, 2013).

6.4 Ethical approval

Ethical approval was obtained from the UCL Research Ethics Committee, and contained within the Project ID number 5766/002: Development and validation of the self-regulation of eating behaviour questionnaire (Appendix 6.2).

6.5 Results

6.5.1 Sample

Results from the on-line responses to the AEBQ were obtained from 954 adults aged 18 to 79, with a mean age of 44.5 ± 12.9 and a mean BMI of 26.1 ± 5.8 (Sample 2). Descriptive characteristics of Sample 1, recruited more than one year prior to Sample 2 to allow for comparison between these two groups, are also presented. Results are also shown for a sub-sample of 93 respondents from Sample 2 (20 to 64 years old, mean age 48.6 ± 12.8), who completed the AEBQ again two weeks later to assess test-retest reliability. The descriptive characteristics of all three samples are shown in Table 6.1. No differences in age group, gender, BMI category, ethnicity or education were found between Samples 1 and 2.

Table 6.1 Descriptive statistics of adult samples used to carry out PCA (Sample 1), and CFA and re-test sample (Sample 2)

	Sample 1		Sample 2	
	PCA (n=708)	CFA (n=954)	Re-test (n=93)	
	n (%)	n (%)	n (%)	
Age				
18 to 29	301 (42.5%)	166 (17.4%)	9 (9.7%)	
30 to 59	300 (42.4%)	654 (68.6%)	59 (63.4%)	
60 +	107 (15.1%)	134 (14.0%)	25 (26.9%)	
Gender				
M	336 (47.5%)	407 (42.7%)	19 (20.4%)	
F	372 (52.5%)	547 (57.3%)	74 (79.6%)	
BMI	n=674*	n=940**	n=90	
Underweight	30 (4.4%)	25 (2.7%)	2(2.2%)	
Normal weight	328 (48.7%)	380 (39.8%)	40 (44.4%)	
Overweight	173 (25.6%)	278 (29.1%)	25 (27.8%)	
Obese	143 (21.2%)	257 (26.9%)	23 (24.7%)	
Ethnicity	n=703			
White	635 (90.3%)	863 (90.5%)	91 (97.8%)	
Non-white	68 (9.7%)	91 (9.5%)	2 (2.2%)	
Education	n=700			
School	179 (25.6%)	243 (25.5%)	28 (30.1%)	
College	242 (34.6%)	359 (37.6%)	29 (31.2%)	
University	279 (39.9%)	352 (36.9%)	36 (38.7%)	

* See Section 5.5.1.1, Table 5.1, Chapter 5.

** 940 (98.5% of the sample) participants had a BMI range of 14.99 to 48.01

6.5.2 Confirmatory Factor Analysis

The 35 AEBQ indicators, loaded onto their hypothesized underlying factors, resulting in the input diagram from SPSS AMOS seen in Figure 6.1 (Model 1). As seen in Figure 6.1 below, the ranges of loadings obtained for each factor were: 'Hunger and food responsiveness' (HFR), from 0.39 to 0.76; 'emotional over-eating' (EOE), from 0.70 to 0.88; 'enjoyment of food' (EF), from 0.72 to 0.89; 'satiety responsiveness', from 0.57 to 0.83; 'emotional under-eating' (EUE), from 0.65 to 0.84; 'food fussiness' (FF), from 0.71 to 0.89; and 'slowness in eating' (SE), from 0.71 to 0.90, suggesting they were adequate, as they were above the required value of 0.40 (except for HFR from 0.39) (Stevens, 2009) (Figure 6.1). The 'food approach' traits (HFR, EOE, EF) and 'food avoidance' traits (SR, EUE, FF, SE) were positively correlated within the two domains and negatively correlated between the two domains, indicating that each group of scales measures different sets of traits (Figure 6.1).

Table 6.2 shows the AEBQ components with indicator names and numbers for Model 1, which correspond to the final 35 item AEBQ obtained from the PCA in Study 2, Chapter 5 (Appendix 5.10).

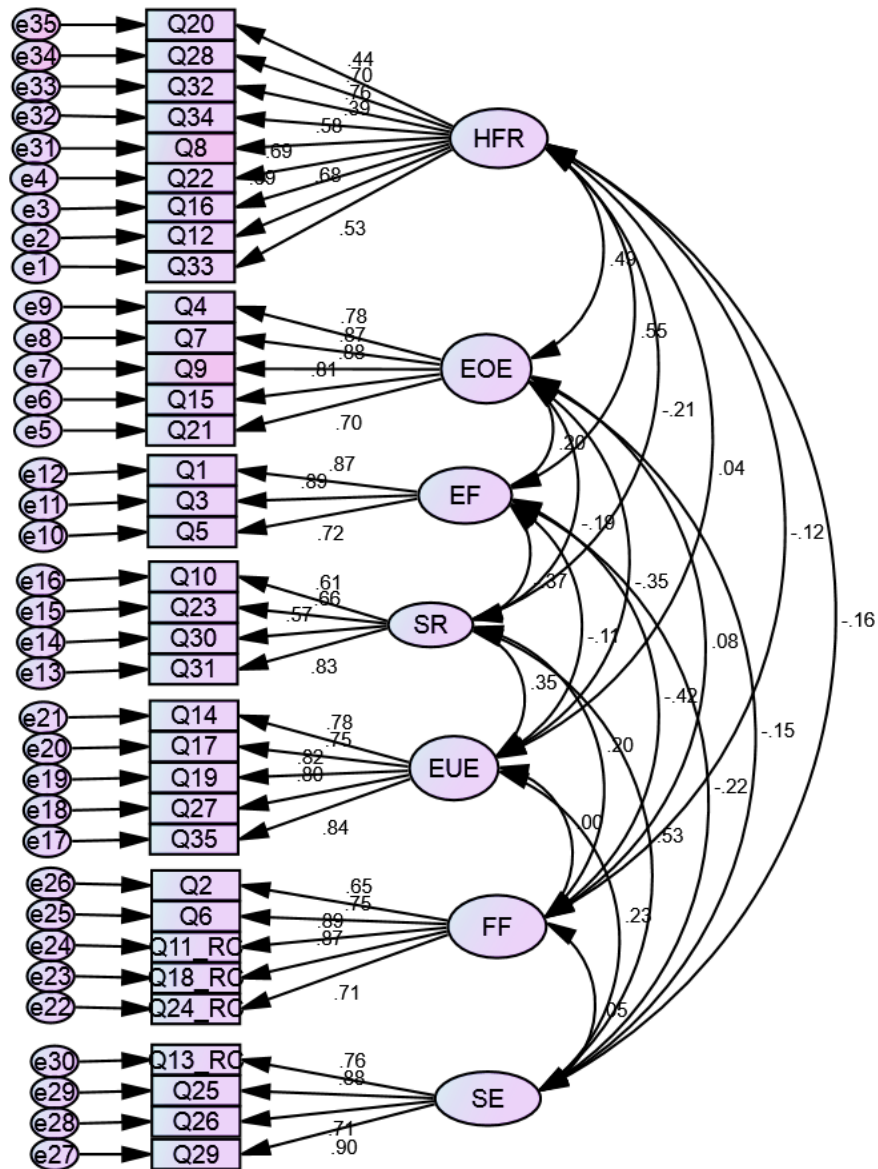


Figure 6.1 CFA model for a 35 item, 7-factor AEBQ (Model 1)

Table 6.2 AEBQ components with indicator names and numbers (Model 1)

Component	Number	Indicator	Factor loading
HFR	Q8	If I miss a meal I get irritable	0.69
	Q20	I often notice my stomach rumbling	0.44
	Q28	I often feel so hungry that I have to eat something right away	0.70
	Q32	I often feel hungry	0.66
	Q34	If my meals are delayed I get light-headed	0.39
	Q12	I often feel hungry when I am with someone who is eating	0.68
	Q16	Given the choice, I would eat most of the time	0.69
	Q22	I am always thinking about food	0.69
	Q33	When I see or smell food that I like, it makes me want to eat	0.53
EOE	Q4	I eat more when I'm annoyed	0.78
	Q7	I eat more when I'm worried	0.87
	Q9	I eat more when I'm upset	0.88
	Q15	I eat more when I'm anxious	0.81
	Q21	I eat more when I'm angry	0.70
EF	Q1	I love food	0.87
	Q3	I enjoy eating	0.89
	Q5	I look forward to mealtimes	0.72
SR	Q23	I often get full before my meal is finished	0.61
	Q10	I often leave food on my plate at the end of a meal	0.66
	Q30	I cannot eat a meal if I have had a snack just before	0.57
	Q31	I get full up easily	0.83
EUE	Q14	I eat less when I'm worried	0.78
	Q17	I eat less when I'm angry	0.75
	Q19	I eat less when I'm upset	0.82
	Q27	I eat less when I'm annoyed	0.80
	Q35	I eat less when I'm anxious	0.84
FF	Q6	I refuse new foods at first	0.65
	Q18	I am interested in tasting new food I haven't tasted before*	0.75
	Q2	I often decide that I don't like a food, before tasting it	0.89
	Q11	I enjoy tasting new foods*	0.87
	Q24	I enjoy a wide variety of foods*	0.71
SE	Q13	I often finish my meals quickly*	0.76
	Q25	I am often last at finishing a meal	0.88
	Q26	I eat more and more slowly during the course of a meal	0.71
	Q29	I eat slowly	0.90

* Items were reverse scored when calculating scale means and Cronbach's alphas.

Food approach scales: HFR: 'hunger and food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'.

Food avoidance scales: SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE, 'slowness in eating'.

Model 1 resulted in reasonable, but not good model fit: RMSEA = 0.061, NFI=0.871, CFI=.0896, $\chi^2(df=539) = 2431.345$, $p < 0.001$ (Hu & Bentler, 1999) (Table 6.3). The CFI was below 0.90 and the RMSEA above 0.06, which are the cut-offs that indicate a good model fit. After looking at the modification indices and the co-varied error terms with the largest parameter changes that were part of the same factor (Dugard et al., 2010), too many unexplained correlations were found between the errors of the indicators on the 'hunger and food responsiveness' factor. These results are seen in Figure 6.2, still as part of Model 1.

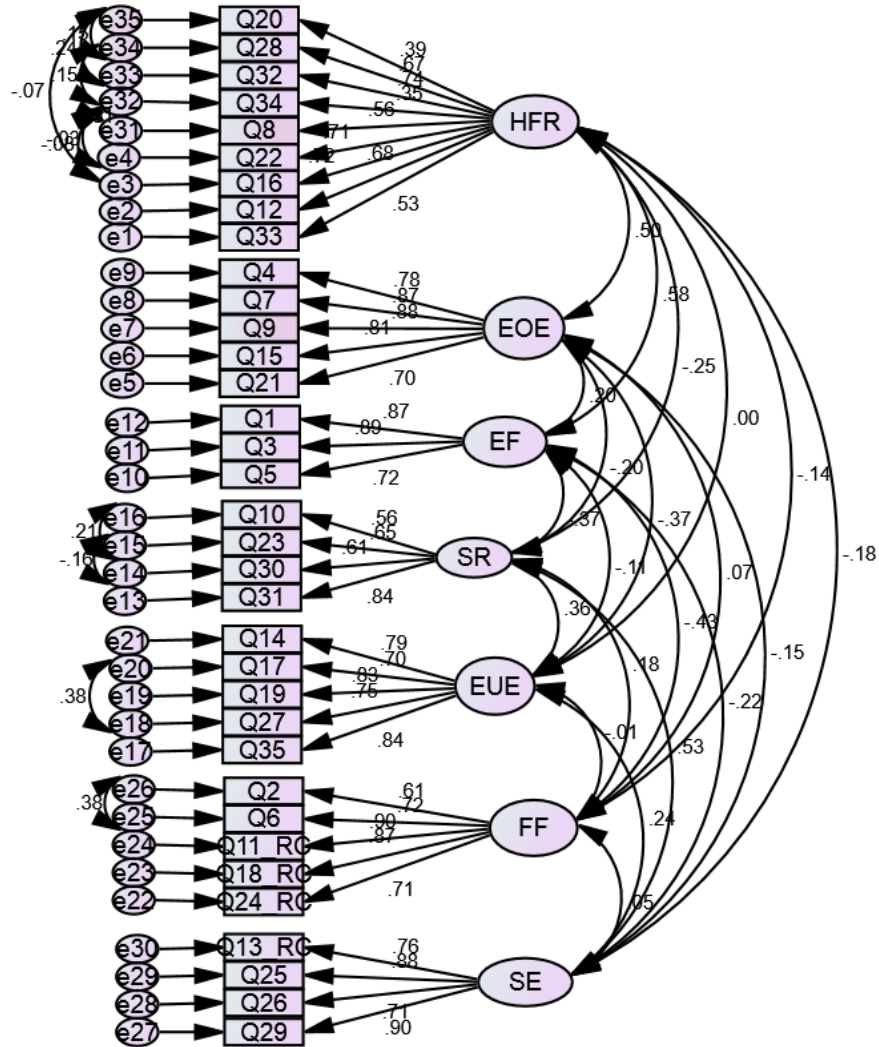


Figure 6.2 CFA model for a 35 item, 7-factor AEBQ with covariances between errors (Model 1)

The modification indices and co-variances of error terms on the same factors in competing models were examined. In the model with the lowest AIC and BIC values (i.e. the model with the best fit to the data), too many unexplained correlations were found between error terms. To correct this issue, the 'hunger and food responsiveness' factor was split into two

separate factors: 'hunger' and 'food responsiveness'; each indicator was allowed to load on to their respective factor (Figure 6.3) (Model 2). The ranges of factor loadings obtained for these two new factors were: 'hunger' (H) from 0.44 to 0.79 and 'food responsiveness' (FR) from 0.55 to 0.72, all above the minimum 0.40 (Stevens, 2009). 'Hunger' and 'food responsiveness' were strongly correlated (0.86) (Figure 6.3). Correlations between 'food approach' traits and 'food avoidance' traits remained the same as those observed in Figure 6.1 and Figure 6.2 for Model 1 (with and without covariances for error terms).

Table 6.3 shows the AEBQ components with indicator names and numbers for Model 2, taken from the original AEBQ (Appendix 5.10).

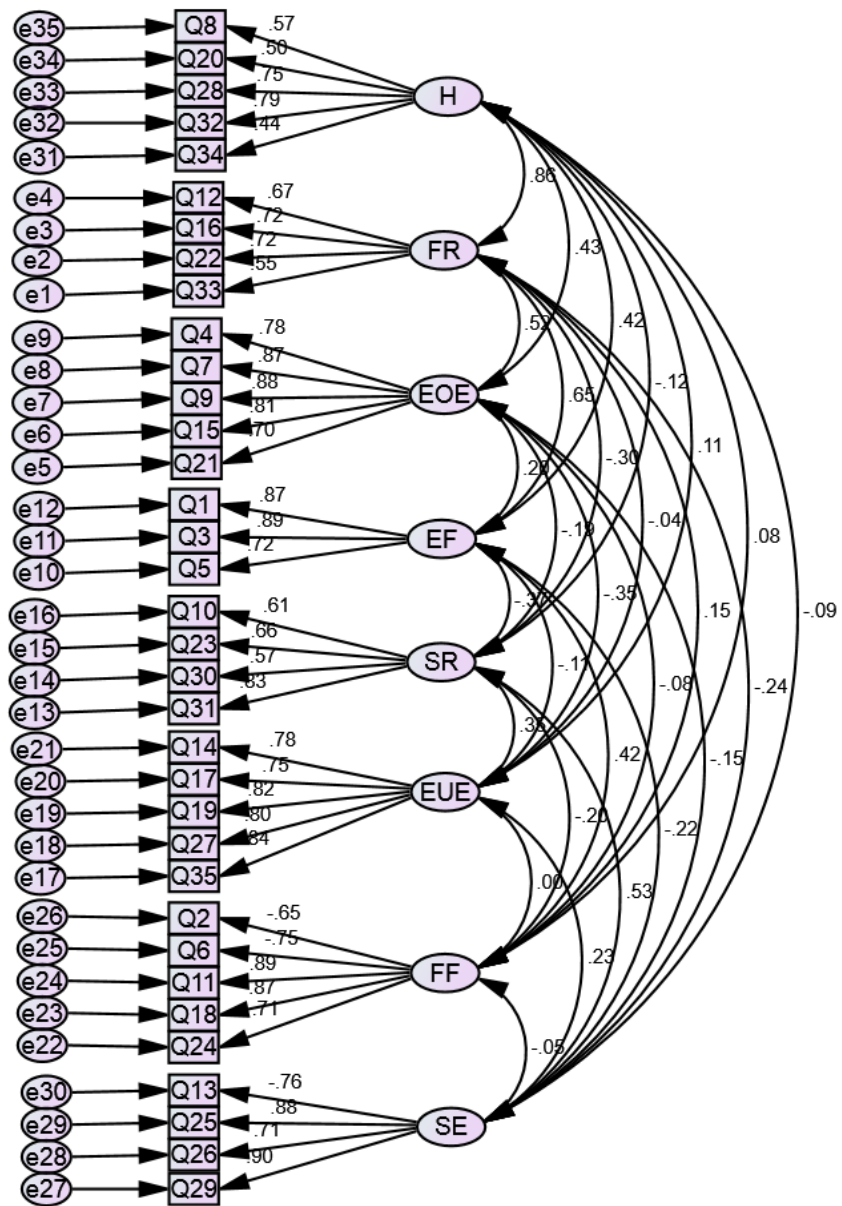


Figure 6.3 CFA for model a 35 item, 8-factor AEBQ, with 'hunger' and 'food responsiveness' separated (Model 2)

Table 6.3 AEBQ components with indicator names and numbers (Model 2)

Component	Number	Indicator	Factor loading
H	Q8	If I miss a meal I get irritable	0.57
	Q20	I often notice my stomach rumbling	0.50
	Q28	I often feel so hungry that I have to eat something right away	0.75
	Q32	I often feel hungry	0.79
	Q34	If my meals are delayed I get light-headed	0.44
FR	Q12	I often feel hungry when I am with someone who is eating	0.67
	Q16	Given the choice, I would eat most of the time	0.72
	Q22	I am always thinking about food	0.72
	Q33	When I see or smell food that I like, it makes me want to eat	0.55
EOE	Q4	I eat more when I'm annoyed	0.78
	Q7	I eat more when I'm worried	0.87
	Q9	I eat more when I'm upset	0.88
	Q15	I eat more when I'm anxious	0.81
	Q21	I eat more when I'm angry	0.70
EF	Q1	I love food	0.87
	Q3	I enjoy eating	0.89
	Q5	I look forward to mealtimes	0.72
SR	Q23	I often get full before my meal is finished	0.61
	Q10	I often leave food on my plate at the end of a meal	0.66
	Q30	I cannot eat a meal if I have had a snack just before	0.57
	Q31	I get full up easily	0.83
EUE	Q14	I eat less when I'm worried	0.78
	Q17	I eat less when I'm angry	0.75
	Q19	I eat less when I'm upset	0.82
	Q27	I eat less when I'm annoyed	0.80
	Q35	I eat less when I'm anxious	0.84
FF	Q6	I refuse new foods at first	0.65
	Q18	I am interested in tasting new food I haven't tasted before*	0.75
	Q2	I often decide that I don't like a food, before tasting it	0.89
	Q11	I enjoy tasting new foods*	0.87
	Q24	I enjoy a wide variety of foods*	0.71
SE	Q13	I often finish my meals quickly*	0.76
	Q25	I am often last at finishing a meal	0.88
	Q26	I eat more and more slowly during the course of a meal	0.71
	Q29	I eat slowly	0.90

* Items were reversed for scoring.

Food approach scales: H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'.

Food avoidance scales: SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'.

The 8-factor model (Model 2) produced a better model fit than Model 1: RMSEA = 0.058, NFI=0.880, CFI=0.905, $\chi^2(df=532) = 2254.657$, $p < 0.001$. The AIC and BIC measures were lower for Model 2 than Model 1 (Table 6.4) indicating Model 2 best fits the data.

Table 6.4 Model fit indices for Models 1 and 2 in CFA of the AEBQ

Model	Items	Factors	Exogenous variables	NFI	CFI	RMSEA	χ^2	df	AIC	BIC
Model 1	35	7 (H+FR on a single factor)	42	0.871	0.896	0.061	2431.345	539	2613.345	3055.665
Model 2	35	8 (H + FR as separate factors)	43	0.880	0.905	0.058	2254.657	532	2450.657	2927.002

FR: 'Food Responsiveness'; H: 'Hunger'.

AIC: 'Akaike's Information Criteria'; BIC: 'Bayesian Information Criterion'; CFI: 'Comparative Fixed Index'; χ^2 : 'Chi-square'; df: 'degrees of freedom'; NFI: 'Normed Fixed Index'; RMSEA: 'Root Mean Square Error of Approximation'.

6.5.3 Internal and external reliability

Table 6.5 shows the Cronbach's alphas for internal reliability and ICC for test-retest reliability (Field, 2013). Cronbach's alphas were all above 0.70 (α range = 0.751 to 0.904) for internal reliability, indicating that the scales for each appetitive trait are reliable. Test-retest reliability was also good, with all Cronbach's alphas greater than 0.70 (α range = 0.732 to 0.910).

Table 6.5 Internal and test-retest reliability measures for the AEBQ in an adult sample

Factor	Internal reliability (Cronbach's alphas) (n=954)	Test re-test reliability (ICC, 95% CI) (n=93)
Hunger	0.751	0.821 (0.730 to 0.881)
Food responsiveness	0.753	0.871 (0.805 to 0.914)
Emotional over-eating	0.904	0.732 (0.596 to 0.823)
Enjoyment of food	0.859	0.860 (0.789 to 0.907)
Satiety responsiveness	0.753	0.865 (0.797 to 0.911)
Emotional under-eating	0.896	0.772 (0.656 to 0.849)
Food fussiness	0.877	0.907 (0.860 to 0.939)
Slowness in eating	0.884	0.910 (0.864 to 0.940)

Food approach scales

Food avoidance scales

ICC: Intra-Class Correlation Coefficient; CI: Confidence Interval.

6.5.4 Descriptive statistics of the appetitive trait

Similarly to results in Study 2, Chapter 5, all appetitive traits were normally distributed except for 'enjoyment of food', which was skewed to the right. Descriptive statistics for each appetitive trait are presented in Table 6.6.

Table 6.6 Descriptive statistics of appetitive trait mean scores (n = 954)

	Food approach traits				Food avoidance traits			
	H	FR	EOE	EF	SR	EUE	FF	SE
Mean	2.92	2.98	2.74	4.00	2.61	2.83	2.29	2.62
SD	0.78	0.78	0.98	0.74	0.81	0.92	0.84	0.97
Median	3.00	3.00	2.80	4.00	2.50	2.80	2.20	2.50
Skewness	-0.00	0.16	0.18	-0.69	0.30	0.12	0.40	0.34
Kurtosis	-0.22	-0.28	-0.60	0.60	-0.34	-0.26	-0.35	-0.54

SD = standard deviation

Food approach scales: H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'.

Food avoidance scales: SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'.

Correlations between the appetitive traits are shown in Table 6.7. All correlations are in the expected directions, with the 'food approach' traits correlating positively with each other and negatively with the 'food avoidance' traits, and vice versa.

Table 6.7 Correlations between appetitive traits (n=954)

		Food approach traits			Food avoidance traits			
		FR	EOE	EF	SR	EUE	FF	SE
Food approach traits	H	0.62**	0.36**	0.34**	-0.04	0.12**	-0.03	-0.05
	FR	-	0.44**	0.55**	-0.23**	-0.03	-0.10**	-0.21**
	EOE		-	0.19**	-0.14**	-0.32**	0.09**	-0.14**
	EF			-	-0.28**	-0.10**	-0.36**	-0.20**
Food avoidance traits	SR				-	0.30**	0.20**	0.47**
	EUE					-	0.03	0.21**
	FF						-	0.06

^a Pearson's correlation was used for normally distributed mean scores, except for 'enjoyment of food' where Spearman's rho was used.

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

* Correlation is significant at the 0.05 level (2-tailed)

Food approach scales: H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'.

Food avoidance scales: SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'.

6.5.5 Relationships between BMI and appetitive traits

BMI was positively correlated with 'food responsiveness' ($r=0.07$; $p<0.05$) 'emotional over-eating' ($r=0.26$; $p<0.01$) and 'enjoyment of food' ($r=0.07$; $p<0.05$) ('food approach' traits), and negatively correlated with 'satiety responsiveness' ($r=-0.13$; $p<0.01$), 'emotional under-eating' ($r=-0.20$; $p<0.01$) and 'slowness in eating' ($r=-0.11$; $p<0.01$) ('food avoidance' traits). No relationships were found between BMI and 'hunger' or 'food fussiness' (Table 6.8). These correlations were carried out in the complete sample with realistic BMI values ($n=940$).

Table 6.8 Correlations between BMI and appetitive traits in the total adult sample (n=940)

	Food approach traits				Food avoidance traits			
	H	FR	EOE	EF	SR	EUE	FF	SE
BMI	-0.03	0.07*	0.26**	0.07*	-0.13**	-0.20**	0.03	-0.11**

* Correlation is significant at the 0.05 level (2-tailed).

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

Food approach scales: H: 'hunger'; FR: 'food responsiveness'; EOE: 'emotional over-eating'; EF: 'enjoyment of food'.

Food avoidance scales: SR: 'satiety responsiveness'; EUE: 'emotional under-eating'; FF: 'food fussiness'; SE: 'slowness in eating'.

Table 6.9 shows the results from the multiple linear regression model predicting BMI from the appetitive traits measured in the AEBQ, after controlling for age and gender. All assumptions for linear regressions were met. Significant associations remained between higher 'food responsiveness' ($\beta=1.208$; 95% CI: 0.710 to 1.706; $p<0.001$), 'emotional over-eating' ($\beta=1.903$; 95% CI: 1.530 to 2.777; $p<0.001$), 'enjoyment of food' ($\beta=-1.277$; 95% CI: 0.306 to 1.329; $p=0.002$) and BMI. Significant associations also remained between lower 'satiety responsiveness' ($\beta=-0.934$; 95% CI: -1.405 to -0.462; $p<0.001$), 'emotional under-eating' ($\beta=-0.195$; 95% CI: -1.689 to -0.866; $p<0.001$), and 'slowness in eating' ($\beta=-0.672$; 95% CI: -1.060 to -0.283; $p=0.001$) and BMI. No associations were found between either 'hunger' or 'food fussiness' and BMI. Thus, for example, an increase in one point for 'food responsiveness', resulted in an increase in 1.208 points in BMI ($p<0.001$), which explains 5.6% of the variance.

Table 6.9 Multiple linear regression for BMI and appetitive traits (n=940)

Appetitive traits	β coefficient (SE)	95% CI for β	P value	R ²
'Food approach'				
Hunger	0.346 (0.259)	-0.163 to 0.854	0.182	0.034
Food responsiveness	1.208 (0.254)	0.710 to 1.706	0.000	0.056
Emotional over-eating	1.903 (0.191)	1.530 to 2.277	0.000	0.125
Enjoyment of food	0.817 (0.261)	0.306 to 1.329	0.002	0.043
'Food avoidance'				
Satiety responsiveness	-0.934 (0.240)	-1.405 to -0.462	0.000	0.048
Emotional under-eating	-1.277 (0.210)	-1.689 to -0.866	0.000	0.070
Food fussiness	0.285 (0.231)	-0.167 to 0.738	0.216	0.034
Slowness in eating	-0.672 (0.198)	-1.060 to -0.283	0.001	0.044

Note: Age and gender as covariates.

β coefficient: Un-standardised values of β ; CI: Confidence Intervals; SE: Standard Error; R²: Coefficient of determination.

6.6 Discussion

The CFA revealed that the best model fit for the AEBQ was to separate the 'hunger' and 'food responsiveness' traits, resulting in an eight factor model of the AEBQ. CFA confirmed that although 'hunger' and 'food responsiveness' have some overlapping qualities, they stand alone as separate dimensions of appetite in adults (Meyer & Pudel, 1972; Schachter & Gross, 1968; Schachter, 1968; Stunkard & Fox, 1971). The final eight scales have good internal reliability (all Cronbach's alphas > 0.7) (Field, 2013), consistent with the results obtained in Study 2, as well as previous studies of the CEBQ (Ashcroft et al., 2008) and the BEBQ (Llewellyn, van Jaarsveld, et al., 2011). The AEBQ also showed good test-retest

reliability (all Cronbach's alphas > 0.70). This is consistent with test-retest reliability results reported for the CEBQ, with the exception of 'emotional over-eating' and 'emotional under-eating' which showed lower test-retest reliability in the original children's version of the questionnaire (Wardle, Guthrie, et al., 2001). The increased stability of emotional eating traits measured by the AEBQ may reflect a better ability to capture 'emotional eating' behaviours in adults through self-report, as opposed to parent-report for the CEBQ which allows for potential parental bias.

Consistent with results from Study 2 (Sample 1), correlations between scores for the appetitive traits were positively correlated with one another, while the correlations between traits in the 'food avoidance' and 'food approach' dimensions were generally negative. These correlations between traits are consistent with those seen in the CEBQ and the BEBQ (Llewellyn, van Jaarsveld, et al., 2011; Wardle, Guthrie, et al., 2001).

6.6.1 Relationships with BMI and appetitive traits

Regardless of age and gender, adults with a higher BMI had higher scores for 'food responsiveness', 'emotional over-eating' and 'enjoyment of food' and lower scores for 'satiety responsiveness', 'emotional under-eating' and 'slowness in eating'. However, no significant associations were found between BMI and the newly added construct 'hunger' or 'food fussiness'. The new AEBQ 'hunger' scale is a measure of physical hunger (e.g. stomach rumbles) unrelated to emotional or restraining situations as measured in the TFEQ-R18 (Karlsson, Persson, Sjöström, & Sullivan, 2000; Stunkard & Messick, 1985). It is possible that people find it difficult to assess their level of physical hunger, perhaps due to its relationship to forms of 'disinhibition' and issues with eating regulation (Karlsson et al., 2000). However, these null findings may also indicate that people become overweight for reasons other than having an increased level of hunger. It is also likely that individuals differ in their perception and interpretation of what hunger actually means (Wardle, 1987). As seen in the factor loadings, the relationship between 'hunger' and 'food responsiveness' was very high, although the CFA ultimately revealed separating these scales provided the best model fit. Future studies using the AEBQ will determine if it is necessary to retain the 'hunger' scale as an important appetitive trait in adults.

The lack of association between BMI and 'food fussiness' in adults might reflect the fact that 'food avoidance' resulting from 'food fussiness' in adults could be directed towards a much smaller number of foods, while greater variation exists in relation to children's 'food

fussiness' (Croker et al., 2011; Spence et al., 2011; Webber et al., 2009). In adults, picky eating which is sometimes interchangeably used with 'food fussiness', has been associated with a series of anomalous eating behaviours and attitudes towards food, particularly rejecting food based on sensory and olfactory characteristics, as well as from contact with other food or because the food was touched by another person (Kauer, Pelchat, Rozin, & Zickgraf, 2015). This study conducted in the USA by Kauer et al., showed that over a third of adults reported being a 'picky' eater, which is higher than has been observed in children. However, relationships between 'food fussiness' measured using the CEBQ and BMI have also been inconsistent in children, with some studies finding negative associations with weight (Loh et al., 2013; Mackenbach et al., 2012; Rodenburg et al., 2012; Spence et al., 2011; Svensson et al., 2011), while others report no association between 'food fussiness' and child BMI-SDS (Cao, Svensson, Marcus, Zhang, & Sobko, 2012; Santos et al., 2011; Soussignan et al., 2012; Sparks & Radnitz, 2012). Once again, future studies will be needed using the AEBQ to establish if 'food fussiness' remains as a useful sub-scale in this measure.

Overall, 'food responsiveness', 'enjoyment of food' and 'emotional over-eating' are the most common 'food approach' scales that show positive associations with weight in children (Croker et al., 2011; Santos et al., 2011; Sleddens et al., 2008; Soussignan et al., 2012; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009). The most common negative associations with weight in childhood are seen with 'satiety responsiveness' and 'slowness in eating' (Croker et al., 2011; Parkinson et al., 2010; Santos et al., 2011; Soussignan et al., 2012; Webber et al., 2009). The relationships between appetitive traits and BMI observed in this adult sample are consistent with findings from the child literature, although the correlations are slightly smaller in magnitude ('satiety responsiveness' -0.13 [$p < 0.05$] in this study, vs -0.19 in three to five year olds and -0.23 in eight to 11 year olds, both $p < 0.001$) (Carnell & Wardle, 2008a)]; which may be indicative of appetitive traits exerting a differential influence on weight across the life course. Overall, these results suggest that the relationships between appetitive traits and weight previously observed in children still stand in adulthood. Any discrepancies may be a consequence of adults' reporting their own appetite as opposed to parents' reporting on behalf of their child. For example, social desirability might influence adult reporting of appetite to a greater extent, as discussed previously in Section 2.4.2.1, Chapter 2. Adults are also more likely to engage in weight loss and weight maintenance practices than children and adolescents (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011), and this could suppress the impact of certain traits on BMI, whereas children typically do not exert such control over their eating.

6.6.2 Limitations

There are limitations to this study. As discussed in Study 2 in Chapter 6, data collection through a survey sampling company tends to draw similar people to the questionnaire, which prevented the investigation of ethnic differences in appetitive traits in this sample. Demographic similarities between Sample 1 in Study 2 and Sample 2 in the present study may be due to them being recruited from the same company, even though the two samples were recruited over a year apart. Other limitations of using a survey sampling company include that it might attract more health conscious participants, which could in turn bias the results. Participants might also respond by altering their habitual behaviour due to their heightened awareness of their behaviour from completing the questionnaire (Hawthorne effect) (Lanigan, Wells, Lawson, & Lucas, 2001).

Weight and height were self-reported which is likely to have resulted in weight being under-estimated and height over-estimated, leading to an under-estimation of BMI (Gorber, Tremblay, Moher, & Gorber, 2007). Data collection through self-report could also potentially exclude participants due to under-estimation of BMI, if the self-reports are under-estimates to the degree that participants are incorrectly classified as underweight (Cameron & Evers, 1990; Johnson, Beeken, Croker, & Wardle, 2014; Nawaz, Chan, Abdulrahman, Larson, & Katz, 2001). Compared to the results for the most recent Health Survey for England 2013 (Health and Social Care Information Centre, 2014), where 41% of men were overweight and 24% were obese, this study obtained a sample of 36.4% overweight and 26.8% obese men. In the case of women, the Health Survey for England 2013 results were 33% overweight and 26% obese, compared to 25.8% overweight and 28.9% of obese women in this study. Therefore, although age quotas were selected to obtain the most representative sample, these percentages were not quite obtained, falling mostly short in overweight representation for both men and women.

This mis-reporting of height and weight could further explain why the associations between BMI and appetitive traits were smaller than those found in children. The cross-sectional nature of the study precludes any inferences about causation of appetitive traits on BMI and intra-individual continuity of appetitive traits into adulthood. Finally, because the questions referred to eating behaviours and there is general awareness that these may be related to weight, participants may have responded in a socially desirable way, possibly under-reporting 'food approach' behaviours and over-reporting 'food avoidance'

behaviours. If this occurred, it could contribute to the fact that the correlations were smaller than in children (Carnell et al., 2013; Carnell & Wardle, 2008a).

In order to further externally validate the AEBQ for use in different adult samples, it must be determined whether it measures what it is intending to measure (Thompson, 1951). Although CFA is a form of validation, it is preferable to validate newly created questionnaires against other validated appetite measurement instruments (Hyland, Irvine, Thacker, Dawn, & Dennis, 1989) or against laboratory measures of appetite, as was done with the CEBQ (Carnell & Wardle, 2007).

6.6.3 Conclusions

The findings from this study confirm that the structure of the AEBQ, as a self-report measure of appetitive traits in adults, holds true in a different sample of adults. The AEBQ is a 35-item questionnaire, which measures eight appetitive traits. The relationships between appetitive traits and BMI in adulthood in this study were comparable to those observed in children, indicating that approach-related and avoidance-related appetitive traits are systematically (and oppositely) associated with BMI across the life-course. Traits such as 'food responsiveness', 'emotional over-eating' and 'enjoyment of food' were positively associated with BMI, and 'satiety responsiveness', 'emotional under-eating' and 'slowness in eating' were negatively associated with BMI. No associations were found between either 'hunger' or 'food fussiness' and weight, suggesting these traits may not relate to weight in adulthood. Future research should seek to replicate these findings in more diverse samples and using longitudinal designs. Given the associations between the AEBQ and BMI, the AEBQ could also be used to inform weight control interventions, by tailoring advice based appetitive trait scores of overweight and obese individuals. This will be the focus of Study 4 in the following chapter.

Chapter 7. Study 4: Development of a brief appetitive trait tailored intervention in a sample of overweight and obese adults ²⁵

7.1 Background

A key reason for exploring the relationship between appetitive traits and BMI in adulthood is to identify potential targets for intervention. This thesis has so far demonstrated positive correlations between BMI and ‘food approach’ traits (‘food responsiveness’, ‘emotional over-eating’, ‘enjoyment of food’), and negative correlations between BMI and ‘food avoidance’ traits (‘satiety responsiveness’, ‘emotional under-eating’, ‘slowness in eating’) in a large sample of UK adults. If these traits are modifiable, they could represent targets for weight management interventions.

The AEBQ, developed as part of this thesis, enables identification of an individual’s appetitive trait profile. Providing individuals with feedback on their AEBQ scores and tailored weight management advice specific to their individual trait profile, may help them lose weight or maintain their weight. Providing individuals who are overweight or obese with an explanation for their tendency to gain weight that isn’t rooted in low willpower or poor choices, may also help to remove some of the stigma and blame associated with obesity, and help them to feel more confident about managing their weight (Meisel & Wardle, 2014b).

This approach is also supported by research on the benefits of tailoring advice. Tailoring capitalises on people’s desire to receive personalised advice and tailored information is considered to be more relevant than generic communications, and can enhance the effects of health-promoting messages (Kreuter, Strecher, & Glassman, 1999). A study which tailored an individual’s weight management advice according to their genetic risk of obesity, was previously conducted with 18 to 30-year-old university students. Students who received

²⁵ A version of this Study and Study 5 were accepted as an abstract to present in November 2016 at The Obesity Society in New Orleans, USA.

genetic feedback plus corresponding tailored weight management advice were significantly more likely to report being ready to control their weight than students who received general advice alone. This effect was stronger in those who received feedback stating they were at comparatively 'high risk' of obesity according to their genetic test results. However this did not translate to any difference in weight between the groups (Meisel, Beeken, Jaarsveld, & Wardle, 2015).

A review of psychosocial predictors of successful weight loss and weight loss maintenance highlighted a need for more research into individualized approaches to weight management (Teixeira et al., 2005). Few studies have explored the potential to tailor weight management advice based on a person's appetitive traits. Previously, 'eating in the absence of hunger' (EAH) measurements have been used to assign appetite awareness training or cue exposure treatment among overweight and obese children and their parents, in relation to eating disorders (Boutelle et al., 2011; Fisher & Birch, 2002; Tanofsky-Kraff et al., 2008). Both treatments resulted in significant decreases in children's binge eating, with the food exposure treatment also resulting in significant decreases in EAH, while the awareness training program produced no change in EAH (Boutelle et al., 2011).

Several authors have also proposed matched obesity treatments based on the eating behaviour traits captured by the DEBQ, the 'disinhibition' scale of the TFEQ, the 'cognitive restraint' scale of the TFEQ-R18, and the 'Power of Food Scale' (PFS) (Finlayson, Cecil, Higgs, Hill, & Hetherington, 2012; van Strein, van de Laar, et al., 2007). However, it appears that no such studies have been conducted to date and similarly no previous work has explored the provision of tailored weight management advice based on the appetitive traits measured by the CEBQ, and now the AEBQ.

7.2 Aims and objectives

The aim of the present study was to develop and test a brief appetitive trait feedback intervention, to help with weight management in a group of overweight and obese adults. The study falls under the 'development' phase of the Medical Research Council (MRC) framework for developing and evaluating complex interventions (Craig et al., 2008) and corresponds to the first five steps within the Six Steps for Quality Intervention Development (6SQuID; Wight, Wimbush, Jepson, & Doi, 2015). The specific objectives were to:

1. Develop an intervention with tips corresponding to the appetitive traits measured by the AEBQ; and,
2. Test the intervention on a small scale to determine:
 - a. Interest in and acceptability of the intervention, including information on the number of tips followed, response rates, and loss to follow-up;
 - b. Potential impact of the intervention on weight over eight weeks following receipt of the tips; and,
 - c. Participants' experience of the intervention, including compliance with the tips, the perceived usefulness of the tips and barriers to use of the tips.

7.3 Intervention development

The development of a low intensity, internet-based, 'Appetitive Trait Tailored Intervention' (ATTI), was conducted in line with the Six Essential Steps for Quality Intervention Development (6SQuID) outlined in Table 7.1 (Wight et al., 2015). It follows Steps 1 through 5 of the 6SQuID:

Table 7.1 Six steps in public health intervention development

1. Define and understand the problem and its causes.
 2. Clarify which causal or contextual factors are malleable and have greatest scope for change.
 3. Identify how to bring about change: the change mechanism.
 4. Identify how to deliver the change mechanism.
 5. Test and refine on small scale.
 6. Collect sufficient evidence of effectiveness to justify rigorous evaluation/implementation.
-

Source: (Wight et al., 2015)

7.3.1 Step 1. Define and understand the problem and its causes

Chapters 1 and 2 summarised the need for weight management and outlined the various causes of obesity. The "behavioural susceptibility theory" (BST) of obesity proposes that an individual's appetitive traits make them more or less susceptible to certain obesogenic environmental exposures and excess weight gain (Carnell & Wardle, 2008a). Evidence to date has primarily come from studies of children (Carnell & Wardle, 2008a; Sleddens et al., 2008; Spence et al., 2011; van Jaarsveld et al., 2011; Viana et al., 2008). However, the development of the AEBQ (Study 2, Chapter 5), and the finding that appetitive traits measured by the AEBQ are related to BMI in adulthood (Study 3, Chapter 6), suggest that appetitive traits may also play a role in excess weight gain in adulthood.

7.3.2 Step 2. Clarify which causal or contextual factors are malleable and have greatest scope for change

Research exploring the modification of appetitive traits is limited. Twin studies in children have shown a strong genetic contribution to appetitive traits measured by the CEBQ (Llewellyn, Trzaskowski, Plomin, & Wardle, 2013; Llewellyn et al., 2014). However, there is also a significant environmental contribution to variation in these traits, suggesting they would be susceptible to environmental intervention (Llewellyn & Wardle, 2015).

Furthermore, genetic contribution to phenotypic traits does not mean they cannot be modified. The CEBQ 'food fussiness' trait has been shown to be highly heritable in young children and is closely connected with the rejection of certain foods such as vegetables (Fildes, van Jaarsveld, Cooke, Wardle, & Llewellyn, 2016). However, a large body of evidence shows simple repeated exposure intervention can work to decrease the behavioural expression of 'food fussiness' in early childhood (Daniels et al., 2015; Howard, Mallan, Byrne, Magarey, & Daniels, 2012).

It is possible that advice targeting the modification of weight-related appetitive traits could provide a simple personalised weight management intervention for adults. Therefore, weight management tips were developed for the following AEBQ appetitive traits which were considered to be potentially modifiable through behavioural or cognitive changes: high 'food responsiveness', high 'emotional over-eating', low 'satiety responsiveness', and 'fast eating' as the inverse of 'slowness in eating' (i.e. low scores on 'slowness in eating'). No tips were developed for 'enjoyment of food' as it is problematic to make recommendations for 'not enjoying your food' and the responses to this item were highly positively skewed (mean 4.00 ± 0.74), providing limited scope for change. No tips were developed for 'emotional under-eating' or 'food fussiness', as these traits may in fact confer protection against weight gain (Wardle, Guthrie, Sanderson, & Rapoport, 2001), and 'food fussiness' was not associated with BMI in Study 3. Finally, no tips were developed for 'hunger', as again no relationships were seen between this scale and BMI in Study 3.

The idea behind the ATTI was to provide participants with weight management tips based on their AEBQ measured appetitive profile. 'High' and 'low' categories for each appetitive trait were created based on the AEBQ response scale (1; 'strongly disagree' to 5; 'strongly agree'). Individuals were classed as having 'high' scores for the 'food approach' traits ('food responsiveness', and 'emotional over-eating'), if their mean score for each trait was greater

than 3. They were classed as having a 'low' score for 'food avoidance' traits ('satiety responsiveness', and 'slowness in eating'), if their mean score for each trait was less than 3.

During the initial development stages of the intervention, I wanted to find out if individuals wanting to manage their weight would be interested in receiving tailored weight management tips based on their appetitive trait profile. To achieve this aim, participants from Sample 2 (Study 3, Chapter 6), who were members of an on-line survey panel were asked a series of questions after completing the on-line AEBQ. Participants reported their interest in participating in an intervention that incorporated feedback on their AEBQ responses and tailored appetitive trait weight management tips. The full list of questions is provided in Appendix 7.1, questions included:

- "Would you be interested in receiving feedback on your appetitive traits (i.e. styles of eating that could make you gain or lose weight) and tips on how to manage them accordingly?" (Response options: 'yes', 'no', 'maybe');
- "Would you be interested in taking part in a study looking at the effect of giving people feedback on their appetitive traits?" (Response options: 'very likely to take part', 'likely to take part', 'somewhat likely to take part', 'probably would not take part');

Results were obtained from 954 participants (Sample 2, Study 3, Chapter 6). A total of 243/954 (25.5%) participants replied they would not be interested in receiving feedback on their appetitive traits, leaving 711/954 (74.5%) participants who responded to the full feasibility questionnaire. The full descriptive results detailing the target population's interest are presented in Appendix 7.1. When responding to the question "Is there any information you think would be particularly useful for a study on appetitive trait feedback?", participants replied they would be interested in receiving information about 'healthy food options' (444/628; 46.5%), as well as tips on 'eating self-awareness' (373/681; 39.1%). These results were taken into account when developing the tips. When asked "do you think that knowing about your appetitive traits would change how you eat?", very few said 'no' (45/711; 4.7%). Overall, there was enthusiasm for taking part in a study to test these appetitive trait recommendations, with nearly two-thirds (440/711; 61.9%) being 'very likely to take part' or 'likely to take part'.

7.3.3 Step 3. Identify how to bring about change: the change mechanism

The ATTI tips were developed using ‘Shape-Up’ as a starting point. ‘Shape-Up’ is a behavioural weight loss/healthy lifestyle program based on Cognitive Behavioural Therapy (CBT), that has been used in a number of settings (Beeken et al., 2013; Wardle et al., 2013; Wardle, Liao, et al., 2001; Weight Concern, n.d.-b). CBT is the backbone for the majority of successful multi-component weight loss interventions (Kirk et al., 2012; Wardle & Johnson, 2015). Tips were developed for each selected trait, providing simple information that would help participants to modify their behaviours. This was done using simple language in an accessible pdf format.

The ATTI tips leaflet was developed in conjunction with Professor Jane Wardle (Professor of Psychology), Dr Rebecca Beeken (Senior Research Psychologist) and Dr Helen Croker (Dietician). The leaflet consisted of three sections:

The first section gave information on the importance of a healthy weight, how “losing weight might improve my health” (NICE Clinical Guideline 189, 2014), and how appetitive traits may play a role in weight gain. It also contained a feedback section on “your personal appetite profile”, which provided personalized information about the “traits that could be making things more difficult for you”, based on participants’ responses to the AEBQ. If a participant did not have ‘high’ scores for any of the ‘food approach’ traits or ‘low’ scores for any of the ‘food avoidance’ traits (i.e. was not classified as having an ‘adverse’ trait), they were told that they did not have any specific problems with these traits.

The second section of the ATTI tips leaflet contained each individual’s tips for managing their ‘adverse’ traits. A set of weight management tips was developed for each AEBQ-defined ‘adverse’ trait. I used techniques adapted from ‘Shape-Up’ to inform and refine the tips. For example, for high ‘food responsiveness’ (a scale which includes the item; “I often feel hungry when I am with someone who is eating”) the tip “Suggest doing things with friends that don’t involve food, like going for a walk in the park” was developed. This tip is based on ‘response substitution’ techniques to avoid external triggers to eat (Wardle & Johnson, 2015; Wardle et al., 2013). Another example was the use of ‘stimulus control’ techniques (Hartmann-Boyce et al., 2016, 2015; Wardle et al., 2013) utilized in several of the tips, such as “Serve yourself a meal that is the right amount for you” which was developed as a ‘satiety responsiveness’ tip to help prevent participants from over-eating. The ‘emotional over-eating’ tip was the only one to use ‘cognitive restructuring’ (Dalle

Grave et al., 2013; Rapoport et al., 2000; Wadden, Webb, Moran, & Bailer, 2012), “A lot of people find food comforting. When you are feeling upset, annoyed or anxious this may be a risky time. Eating something when you are feeling this way may make you feel better in the short term, but in the long run might make you feel worse, especially if you are trying to manage your weight”.

The newly developed tips were then discussed with other experts in eating behaviour and the original ‘Shape-Up’ authors, reviewed for clarification, and modified. The tips were then further refined by health psychologists who had backgrounds in energy balance. Finally, the ATTI tips were piloted with two individuals who were asked to follow them for a week, to obtain lay input on whether they were easy to understand and feasible.

The third and final section of the ATTI tips leaflet included information and advice about behaviour change techniques that have been highlighted as important for successful weight management interventions in several reviews (Campbell, Johnson, Messina, Guillaume, & Goyder, 2011; Gupta, 2014; Hartmann-Boyce et al., 2014; Stead et al., 2015). These techniques included self-monitoring, goal setting, and the need for social support (Hartmann-Boyce et al., 2016; Michie, Atkins, & West, 2014; Michie et al., 2013). General advice based on these techniques was incorporated into the information sent to the intervention participants (Appendix 7.2 and Appendix 7.3).

The final appetitive trait tips are shown in Table 7.2. ‘Food responsiveness’ had six corresponding tips; ‘emotional over-eating’ one tip; ‘satiety responsiveness’ five tips; and, fast eating or ‘slowness in eating’ had three tips.

Table 7.2 Appetitive trait weight management tips for, ‘food responsiveness’, emotional over-eating’, ‘satiety responsiveness’, and ‘fast eating’

<p>Having high levels of ‘food responsiveness’ means that the sight or smell of food, or even looking at someone else eating, can make you want to eat</p>	<ul style="list-style-type: none"> • Some people are particularly susceptible to food temptations around them. Avoid buying unhealthy foods and don’t have them available in your home. This will help to take away the urge to eat them ^a • Try to identify what specific types of food make you want to eat. So if you walk past a bakery or a particular shop that sells treats you love on your way home, take a different route ^{a b} • If you are with others who are eating and it is not your meal time, try having a low calorie drink such as water with lime/orange, tea or coffee ^b • Suggest doing things with friends that don’t involve food, like going for a walk in the park ^b • Avoid going to the supermarket when you are hungry and use a shopping list. This will help stop you from buying foods you don’t need ^a • Some people can train themselves to resist their ‘problem foods’. You could try this. Start with something easy. If you like salty foods, use a plain cracker, if you like sweet foods, use a plain biscuit. Wrap it up in cling film and leave it by your desk (or somewhere where you see it often). See how you feel about this. Repeat for 10 days, and see if your urge to eat it goes down. Then move to a more desirable cracker or biscuit. Once you’ve done this for several days and have successfully avoided eating the food, repeat the exercise with food on a plate. Remember, sit it out and avoid the temptation to eat. This will help you train yourself to be less responsive to food ^a
<p>If you are an emotional eater you tend to eat to comfort yourself when you feel sad, or worried.</p>	<ul style="list-style-type: none"> • A lot of people find food comforting. When you are feeling upset, annoyed or anxious this may be a risky time. Eating something when you are feeling this way may make you feel better in the short term, but in the long run might make you feel worse, especially if you are trying to manage your weight ^c • Have a plan for another way to comfort yourself that does not involve food. Identify three

	<p>alternatives to eating that might help you distract yourself and that you enjoy doing or that feel like a treat. Talk to a friend about how you feel, play a game, go on social media, read the news, go for a walk ^b</p>
<p>If you have low 'satiety responsiveness' you are less likely to notice when you are full and you may eat more than you need.</p>	<ul style="list-style-type: none"> • Some people over-eat because they have trouble recognising when they are full. Half way through your meal, stop and try to pay attention to how full you are ^a • Serve yourself a meal that is the right amount for you. Don't have second helpings. Put left overs in the fridge or freezer straight away. If you need help with portion sizes, go to: http://www.nhs.uk/Livewell/5ADAY/Pages/Portionsizes.aspx ^a • You may be used to eating more than you need. Retrain yourself. It takes time to get used to eating smaller quantities of food and feeling satisfied. Try using a smaller plate than usual ^a • If someone else is serving - remember you do not have to clear your plate. Left-overs can be thrown away or put away to save for the next day ^a • Avoid 'mindless' eating. Don't eat while you're watching the television, writing an e-mail, or reading. Stop eating if you are doing something else. Try to eat in a designated place and at set times ^a
<p>If you are a fast eater, you tend not to notice when you are full, which can make you over-eat.</p>	<ul style="list-style-type: none"> • Eating slowly gives your brain the time to realise that food has entered your body and energy supply is on its way. This will help you feel full. Try to eat slower than those that are eating around you, and try to be the last one to finish your meal ^a • Put your fork/spoon down in between bites. Take the time to enjoy the taste and the texture of the foods you eat ^a • Always sit down to eat your meals if you can. Standing up or rushing from one place to the next tends to increase speed of eating ^a

^a Stimulus control ^b Response substitution ^c Cognitive restructuring

The appetitive trait sheet in a pdf format was designed to be visually appealing, including different colours and imagery, with accessible font and layout. Appendix 7.2 shows an example of an ATTI leaflet sent to a participant who had adverse scores for all four traits: 'food responsiveness' and 'emotional over-eating', and low scores for 'satiety responsiveness' and 'slowness in eating' (i.e. was a fast eater). A second example of the tailored ATTI leaflet is provided for a participant who had adverse scores for three traits: 'food responsiveness', and low 'satiety responsiveness' and 'slowness in eating' (Appendix 7.3).

7.3.4 Step 4. Identify how to deliver the change mechanism

In order for weight loss advice to be delivered on a large-scale and cost-effectively, it needs to be brief. Brief interventions have the potential to be integrated into routines and can reach a broader audience (Clark, Hampson, Avery, & Simpson, 2004). Simple advice is also preferred by participants in weight management programmes and has been shown to improve adherence (Mata, Todd, & Lippke, 2010). The internet is an affordable medium of delivery for weight management advice that enables greater coverage than face-to-face intervention delivery (Arem & Irwin, 2011; Hartmann-Boyce et al., 2015).

As part of the feasibility questions completed by participants from Sample 2 (Study 3, Chapter 6), information was obtained on how participants would like to receive the ATTI (Appendix 6.1). Just over half (558/954; 58.5 %) responded 'yes' to receiving appetitive trait-based advice for managing weight and tips on how to manage them accordingly; 153/954 (16.0%) replied 'maybe'. Of the 711 (74.5%) participants who responded to the feasibility questions, the majority (611/711; 85.9%) said they would prefer to receive this information 'via e-mail' and just under two-thirds (452/711; 63.4%) wanted input/tips provided 'weekly' over the course of the eight-week intervention. Refer to Appendix 7.1 for full descriptive results detailing the target population's interest.

Together, existing literature and the findings from the feasibility study provide support for a brief, tailored weight management intervention delivered via the internet. Adults reported being interested in participating in a weight management intervention delivered via e-mail and tailored to their individual appetitive traits. Step 5, will therefore seek to test the ATTI in overweight and obese adults wanting to manage their weight for future refinement.

7.4 Methods - Step 5. Testing the intervention on a small scale

The testing of the ATTI was conducted on-line, using a pre-post design with follow-up of participants at eight weeks. The study started between the months of June-July 2015 and ended eight weeks later in August-September 2015.

7.4.1 Participants

Overweight and obese participants (BMI ≥ 25) were recruited via the Weight Concern 'Big Panel' - an on-line panel of approximately 1800 people, who have first-hand experience of being overweight and weight management attempts (Weight Concern, 2016c) (Appendix 7.4). Once 'Big Panel' members were initially contacted, those potentially interested in participating in a tailored intervention were sent a second link to assess inclusion criteria to the study (Appendix 7.5).

7.4.2 Inclusion and exclusion criteria

Individuals who were eligible to take part in the study had to be over 18 years of age, be overweight or obese (BMI ≥ 25), and had to be willing to take part in the study. Individuals were excluded if they were unable to give consent, if they were pregnant, or if they had a terminal illness (Appendix 7.5).

7.4.3 Measures

Participants completed a questionnaire at baseline, along with questions on food preferences which served for another fellow PhD student and were not part of this thesis (Section 7.6). Selected questions were repeated at the end of the eight-week intervention. This is provided in Appendix 7.4 and is described below. The questionnaire was completed on-line using Survey Monkey.

7.4.3.1 Demographic

Demographic information was collected at baseline. Participants reported their gender, age (in years), and marital status. Participant responses for marital status were collapsed into three groups for analysis: 'Single' ('Single'), 'cohabiting' ('Married/Living with partner'), 'other' ('Divorced/Separated/Widowed') (Appendix 7.4).

Information was collected on participants' ethnicity, and level of education. Ethnicity data was collapsed into two categories: 'White' and 'Non-white' ('Black', 'Asian' or 'Mixed').

Education data was collapsed into three categories for analyses: 'School' ('Primary school/Secondary school/O-level/GCSE'), 'College' ('A levels/Technical or trade certificate/Diploma'), and 'University' ('Undergraduate degree/Postgraduate degree'). Participants reported their current employment status which was grouped as; 'employed' ('Employed full-time/ Employed part-time/Self-employed'), 'not employed' ('Unemployed/Full-time homemaker/Unpaid voluntary work/Student'), and 'disabled or retired' ('Disabled or too ill to work/Retired'). They also reported their current living arrangement which was categorized as: 'Home owner' ('Own home outright/Own home with mortgage'), 'renting' ('Rent from local authority/Housing association/Rent privately') or 'other' ('Living with parents/Living in University/College residential accommodation') (Appendix 7.4).

7.4.3.2 Anthropometric

Weight and height were self-reported at the start of the intervention and after the end of the eight-week period, via e-mail. These measurements were used to calculate initial BMI and final BMI categories. BMI values between 25 and 29.9 were classified as 'overweight', and BMI values greater or equal to 30 were classified as 'obese'.

7.4.3.3 Appetitive traits

The 35-item AEBQ was completed at baseline (Appendix 5.10, Appendix 7.4). AEBQ responses for each participant were scored in the standard way (Study 2 and 3, Chapters 5 and 6), and scale scores were used as the basis for their appetitive trait profile, as described above in Section 7.3.3.

7.4.3.4 Number of tips followed

The proportion of participants that received each tip was calculated, alongside the proportion of participants who received all the tips (four tips), three tips, two tips or one tip.

7.4.3.5 Response rate and loss to follow-up

The response rate was obtained from the Survey Monkey replies to e-mails sent to the 'Big Panel'. Those participants who gave their weight at the end of the eight weeks were classified as 'completers'. 'Non-completers' did not give their weight at the end of the intervention. Withdrawals were recorded alongside reasons for drop out when provided.

7.4.3.6 Effects on weight

Changes in weight over the eight-week period served as preliminary data for the intervention's effect on weight. Weight change over the study period was categorized as: 'kept the same weight', 'lost weight', 'gained weight', and 'don't know final weight' ('non-completers' only).

7.4.3.7 Compliance and use of tips

Over the eight-week intervention, the participants were sent a weekly follow-up questionnaire (WFQ) for assessment of compliance, perceived usefulness of the tips and barriers to use of the tips, as well as questions on the use of other weight loss programs, via e-mail (Appendix 7.6).

Each tip was evaluated for compliance (e.g. of a 'food responsiveness tip: "Have you avoided buying unhealthy foods and stopped having them in your home, so that you aren't tempted to eat them?"). Responses for each tip were collapsed into three categories for analysis as: 'All the time/Most of the time', 'A bit of the time', and 'None of the time' (Appendix 7.6).

Participants were asked about the perceived usefulness of the tips: "Overall, do you feel these tips are helping you to manage your 'food responsiveness'/emotional over-eating'/satiety responsiveness'/fast eating?" with response options: 'Yes', 'No', and 'Some of them'. Also a question on goal setting was included: "Have you made any weekly goals for yourself to help you follow these tips?" Response options included: 'Yes' or 'No' (Appendix 7.6).

Barriers to using the tips was assessed with the question: "What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week". Possible response options included: 'Time'; 'Self-motivation'; 'Lack of support from significant others'; 'I don't believe it will help'; 'This week has included different activities from my usual routine'; 'I didn't find it difficult'; and 'Other (please specify)'. Only the tip 'Have you tried to train yourself to resist 'problem foods'?' also included the response option: 'I don't feel I'm ready to carry out this tip' (Appendix 7.6).

Use of other weight loss programs followed alongside the tips was also assessed. Within the WFQ, participants were also asked "are you currently following any other program to

help you manage your weight?”. Responses were categorised into: ‘self-directed weight loss program (e.g. following a low fat, low carbs, counting calories or in general trying to eat a healthy diet)’; ‘program-led weight loss (e.g. following a weight loss group, website app, or diet book)’; ‘strict elimination diet (e.g. fasting, using replacement meals)’; ‘increased physical activity’; ‘not following any other weight loss program’; ‘other (please specify)’ (Appendix 7.6).

7.4.4 Recruitment

In April 2015 members of the ‘Big Panel’ were contacted by e-mail and invited to take part in an on-line questionnaire (Appendix 7.4). The e-mail contained brief information about the ATTI study and a Survey Monkey link to the on-line questionnaire described above. Panel members who completed this questionnaire and reported being “interested in receiving feedback on their eating behaviour and appetite” were then contacted again via the e-mail address they provided. In May 2015, interested participants were sent a new Survey Monkey link containing an information sheet with further details about the study, and a brief screening questionnaire to determine eligibility (Appendix 7.5). Eligible participants were asked to sign a consent form and given the opportunity to ask questions (Appendix 7.7). Recruitment lasted until June 2015, when the intervention started.

7.4.5 The intervention

The intervention lasted for eight weeks. Each participant was e-mailed a tailored ATTI leaflet which included their personalised appetitive trait profile and corresponding tips (e.g. in Appendices 7.2 and 7.3). They were sent a weekly reminder to continue following the tips via e-mail over the eight weeks.

7.5 Analyses

7.5.1 Descriptive statistics

Descriptive statistics were produced to show the demographic and anthropometric characteristics of the study ‘completers’ versus ‘non-completers’. For categorical variables, differences were explored using cross-tabulations with Fisher's Exact test, due to the small size of the sample (Field, 2013). An independent sample t-test was used for to explore differences between ‘completers’ vs. ‘non-completers’ by age.

For participants responding to more than one WFQ, their usefulness, goal setting, barriers, and use of other weight loss programs alongside the tips, was based on their modal response. Percentages were calculated from the WFQ to show the proportion of participants that had followed the tips, had found the tips helpful, had set themselves goals for each trait, and had reported any barriers to following the tips. These were analysed based on the total number of participants that followed each tip and who responded to a WFQ. Frequencies were calculated on the total number of individuals who returned a WFQ at least once over the intervention period.

To calculate the overall weight change in the sample, a paired samples t-test was used. Data were checked for normality (Kolmogorov-Smirnov test) and for outliers using boxplots. Effect size was calculated (Cohen's *d*), by dividing the mean difference by the standard deviation of the difference, where a value of 0.2 is considered small, 0.5 medium and 0.8 large (Cohen, 1988).

Cross-tabulations with Fisher's Exact test were used to explore participants' weight loss categories by the number of WFQ responses they replied to, due to the small size of the sample. Statistical analysis was performed using IBM SPSS Statistics version 22.

7.6 Ethical approval

Ethical approval was obtained from the UCL Research Ethics Committee, and contained within the Project ID number 4378/003: Development and pilot testing of a brief feedback intervention concerning appetitive traits and exploratory analysis of food preferences in relation to weight tendencies in a sample of overweight and obese adults (Appendix 7.8). All questions regarding food preferences belonged to a fellow PhD student's research and were not part of this thesis.

7.7 Results

7.7.1 Number of tips followed

In total, 50/53 (94.3%) participants were provided with tips targeting 'high food responsiveness'; 31/53 (58.5%) were given tips for 'high emotional over-eating'; 29/53 (54.7%) were given tips for 'low satiety responsiveness'; and 42/53 (79.2%) were given tips for 'fast eating'. A third of participants 18/53 (34.0%) received two tips, 17/53 (32.1%)

received all four tips, 15/53 (28.3%) received three tips, and three participants received only one tip (5.7%). For a full list of tips given to each individual participant see (Appendix 7.9).

7.7.2 Response rate and loss to follow-up

The initial e-mail was sent to all members of the 'Big Panel' (n~1800), and 138/1800 participants (7.7%); completed an on-line questionnaire and agreed that they would be interested in receiving feedback on their eating behaviour and appetite. Those interested were e-mailed and, 100/138 (72.5% response rate) participants completed a second Survey Monkey questionnaire to establish eligibility. A total of 8/100 (8%) of participants self-reported that they did not meet the inclusion criteria: due to pregnancy (n=4); due to terminal illness (n=3); providing no reason (n=1). Of the remaining 92 eligible participants, 22 (23.9%) were excluded due to: going away on holiday/not being available during the study period (n=20); suffering from severe depression (n=1); or fasting for Ramadan (n=1). Of the 70 eligible respondents, 53 consented to take part (75% response rate) in the development intervention study for a period of eight weeks beginning in June 2015. The flow of participants through the study is shown in Figure 7.1.

Sample demographics are provided in Table 7.3. The majority of participants were women (49/53; 92.5%) and of white ethnic background (48/53 [90.6%]). Participants were aged between 27 to 76 years old (mean \pm sd: 47.9 \pm 11.1), and had a BMI range of 25.4 to 56.8, (mean \pm sd: 35.7 \pm 8.11). They were predominantly married or living with a partner (47 [88.7%]), and most were employed full-time, or part-time or self-employed (38 [71.7%]).

A total of 32/53 (60.4%) participants provided their final weight and were classified as 'completers'. No significant differences were seen between 'completers' and 'non-completers' by age, gender, ethnicity, marital status, education, employment or living arrangements (Table 7.3).

Table 7.3 Demographic characteristics and initial BMI of participants (n=53)

n (%), unless stated	Total sample n=53	Non-completers n=21	Completers n=32	Group difference (test statistic, p)
Age (years; mean±SD)	47.87±11.14	47.19±11.75	48.31±10.89	t(51)=-0.356, p=0.72
Gender				
M	4 (7.5%)	2 (9.5%)	2 (6.3%)	p=0.521*
F	49 (92.5%)	19 (90.5%)	30 (93.8%)	
Initial BMI				
Overweight	19 (35.8%)	7 (33.3%)	12 (37.5%)	$\chi^2(2)=0.09$ 6, p=0.779**
Obese	34 (64.2%)	14 (66.7%)	20 (62.5%)	
Ethnicity				
White	48 (90.6%)	19 (90.5%)	29 (90.6%)	p=0.667*
Non-white	5 (9.4%)	2 (9.5%)	3 (9.4%)	
Marital status				
Single	4 (7.5%)	2 (9.5%)	2 (6.3%)	$\chi^2=3.913$, p=0.205**
Co-habiting	47 (88.7%)	19 (90.5%)	28 (87.5%)	
Other	2 (3.8%)	0 (0.0%)	2(6.3%)	
Education				
School	10 (18.9%)	4 (19.0%)	6 (18.8%)	$\chi^2=0.585$, p=0.869**
College	15 (28.3%)	7 (33.3%)	8 (25.0%)	
University	28 (52.8%)	10 (47.6%)	18 (56.3%)	
Employment				
Employed	38 (71.7%)	15 (71.4%)	23 (71.9%)	$\chi^2=0.302$, p=1.000**
Not employed	6 (11.3%)	2 (9.5%)	4 (12.5%)	
Disabled or retired	9 (17.0%)	4 (44.4%)	5 (55.6%)	
Current living arrangements				
Home owner	44 (83.0%)	17 (81.0%)	27 (84.4%)	$\chi^2=1.518$, p=0.544**
Renting	8 (15.1%)	3 (14.3%)	5 (15.6%)	
Other	1 (1.9%)	1 (4.8%)	0 (0.0%)	

* Fisher's Exact test was not computed, so p value is reported.

** Fisher's Exact test.

Of the 21 participants who were lost to follow-up, five (23.8%) withdrew, two cited lack of time, two cited personal circumstances, and one reported that they could not engage with the intervention. Seven (33.3%) participants were unable to be contacted and nine (42.9%) participants gave no reasons for failing to complete the study (Figure 7.1).

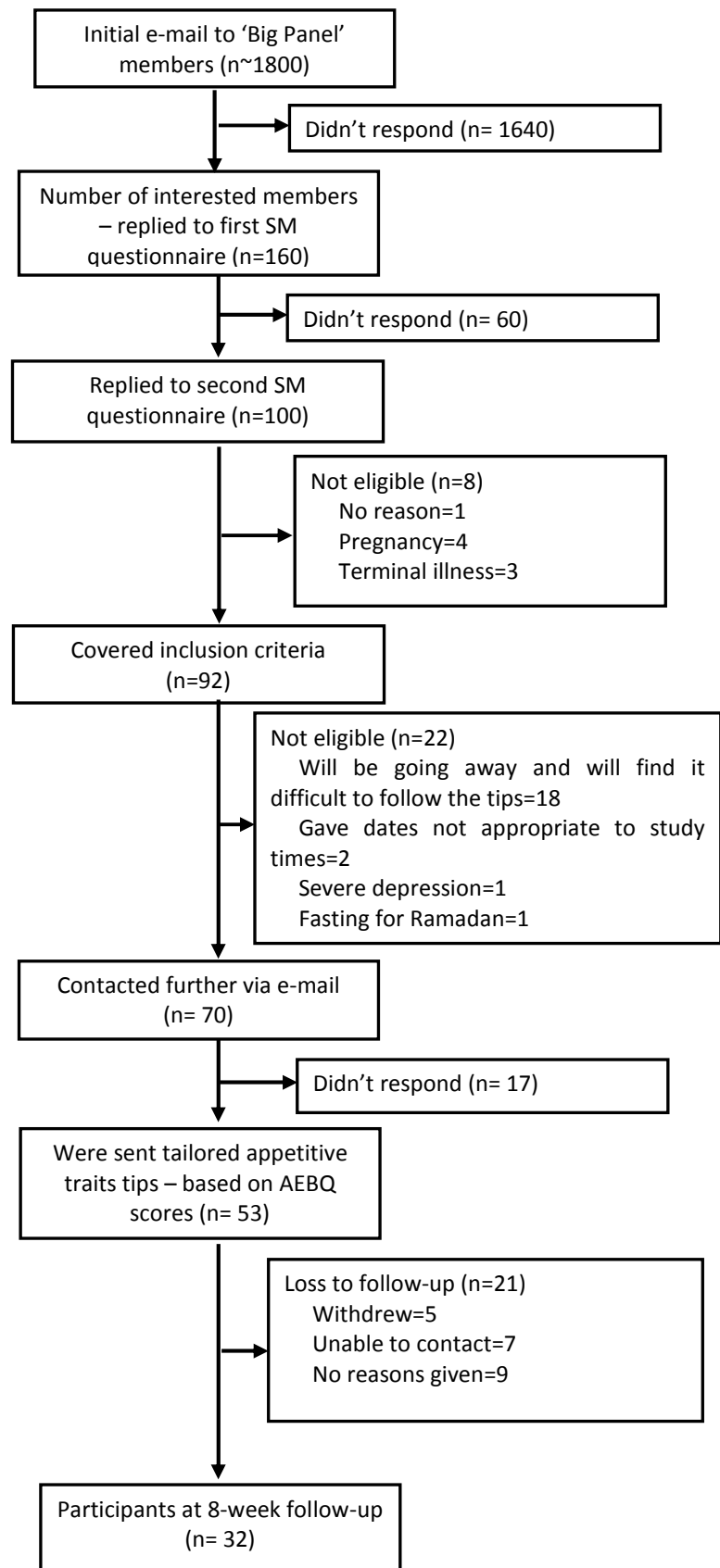


Figure 7.1 Flow chart of participants of the ATTI

7.7.3 Effects on weight

Upon checking for assumptions, one outlier was detected in the weight data (152.90 kg) that was more than 1.5 box-lengths from the edge of the box in a boxplot. Analyses were repeated excluding the outlier (not shown in the results) but the decision was made to include this participant as the findings did not change.

Looking at weight change across the group of ‘completers’, differences in initial weight and final weight were normally distributed, as assessed by Kolmogorov-Smirnov test ($p=0.200$). Participant mean weight was significantly lower after the intervention (mean \pm sd: 90.9 kg \pm 19.4 kg) compared to pre-intervention (mean \pm sd: 92.1 kg \pm 19.8 kg; $t(31) = 2.727$, $p=0.01$) with a medium effect size ($d=0.48$).

Among ‘completers’ ($n=32$), 20/32 (62.5%) participants lost weight, 6/32 (18.8%) kept the same weight, and 6/32 (18.8%) gained weight (overall mean weight loss=-1.2kg, $sd= 0.44$). Among those who lost weight, 10/20 (50.0%) lost less than 5% of their original weight (Mean: 2.5 kg [1.0 kg to 3.7 kg]), 6/20 (30.0%) lost between 5 to 10% weight (Mean: 5.9 kg [5.0 kg to 9.7 kg]) and 4/20 (20.0%) lost more than 10% of their initial weight (Mean: 15.1 kg [10.4 kg to 28.4 kg]). Percentage weight loss for each participant can also be seen in Appendix 7.10.

The number of WFQ that participants responded to did not differ by weight change category ($\chi^2=6.825$, $p=0.109$) (Table 7.4).

Table 7.4 Number of replies to weekly follow-up questionnaires by weight change category in completers

Weight change category n(%)	Weekly follow up questionnaire replies			χ^2 , p
	0 n=5	1-4 n=11	5-8 n=16	
Same weight	2 (33.3%)	1 (16.7%)	3 (50.0%)	$\chi^2=6.825$, $p=0.109^*$
Lost weight	1 (5.0%)	7 (35.0%)	12 (60.0%)	
Gained weight	2 (33.3%)	3 (50.0%)	1 (16.7%)	

* Fisher’s Exact test.

7.7.4 Compliance, perceived usefulness and barriers to use of the tips

Compliance with the tips was assessed based on responses to the WFQ (Table 7.5). WFQ response rates were similar regardless of the appetitive traits being targeted; 68% for those

who received the 'food responsiveness' tips and 'emotional over-eating tips', 72% for those who received the 'satiety responsiveness' tips, and 64% for those who received the fast eating tips provided responses for the WFQ.

Some tips appeared to be better received than others. For example, while all participants reported following the 'food responsiveness' tip "train yourself to resist 'problem foods'?", most participants (62.8%) reported that they did not follow the 'food responsiveness' tip "If you are with others who are eating and it is not your meal time, try having a low calorie drink such as water with lime/orange, tea or coffee". For those who completed the WFQs more than once, responses were similar across the questionnaires and there was no indication that participants might have stopped following the tips as time went on (Table 7.5).

Table 7.5 Number of participants that reported following each tip

	Tips	Number of participants receiving tip ^a	Reported following the tip N (%)		
			All /Most of the time	A bit of the time	None of the time
'Food responsiveness'	Have you avoided buying unhealthy foods and stopped having them in your home, so that you aren't tempted to eat them?	34	15 (44.1%)	15 (44.1%)	4 (11.8%)
	Have you been able to identify specific types of food that make you want to eat and tried to avoid them?	34	15 (44.1%)	14 (41.2%)	5 (14.7%)
	When you have been with others who are eating and it is not your mealtime, have you tried having a low calorie drink?	34	8 (23.5%)	5 (14.7%)	21 (61.8%)
	Have you suggested doing things with friends that do not involve eating?	34	5 (14.7%)	11 (32.4%)	18 (52.9%)
	Have you avoided going to the supermarket when hungry and used a shopping list?	34	22 (64.7%)	5 (14.7%)	7 (20.6%)
	Have you tried to train yourself to resist 'problem foods'?	34	34 (100.0%)	0	0
'Emotional over-eating'	Have you made a plan to comfort yourself with something other than food when you are feeling upset, annoyed or anxious?	21	19 (90.4%)	1 (4.8%)	1 (4.8%)
	Have you stopped and paid attention to how full you feel half-way through your meal?	21	8 (38.1%)	6 (28.6%)	7 (33.3%)
'Satiety responsiveness'	Have you been eating the right portion sizes for you and storing left-overs?	21	10 (47.6%)	7 (33.3%)	4 (19.1%)

Tips	Number of participants receiving tip ^a	Reported following the tip N (%)		
		All /Most of the time	A bit of the time	None of the time
Have you tried retraining yourself to eat smaller quantities of food?	21	4 (19.1%)	14 (66.6%)	3 (14.3%)
Have you stopped clearing your plate?	21	3 (14.5%)	0	19 (90.5%)
Have you avoided mindless eating?	21	10 (47.6%)	9 (42.9%)	3 (14.5%)
'Fast eating'	Have you tried to eat slower than those who are eating around you?	12 (44.5%)	7 (25.9%)	8 (29.6%)
	Have you been putting your fork down in between bites?	7 (25.9%)	11 (40.7%)	9 (33.3%)
	Have you been sitting down for your meals?	26 (96.3%)	1 (3.7%)	0

^a Number of participants who were following a specific tip and who responded to a questionnaire at least once.

Perceived usefulness of the tips was assessed from the WFQ. This was assessed with the questions “Overall, do you feel these tips are helping you to manage your food responsiveness/ emotional over-eating/ satiety responsiveness/ fast eating?”. Table 7.6 shows that around one quarter of participants did not find any of the ‘food responsiveness’, ‘fast eating’ and ‘satiety responsiveness’ tips helpful (23.5% to 28.6%), and the ‘emotional over-eating’ tip was not found to be helpful by three quarters of participants (71.4%).

Table 7.6 Perceived helpfulness of the tips

	Number of participants receiving a tip ^a	Perceived helpfulness of tips n(%)		
		Helpful	Not helpful	Some helpful
‘Food responsiveness’	34	14 (41.2%)	8 (23.5%)	12 (35.3%)
‘Emotional over-eating’	21	6 (28.6%)	15 (71.4%)	N/A
‘Satiety responsiveness’	21	8 (38.1%)	6 (28.6%)	7 (33.3%)
‘Fast eating’	27	12 (44.5%)	7 (25.9%)	8 (29.6%)

^a Number of participants who were following a specific tip and who ever responded to a questionnaire.

When asked if participants had made any weekly goals for themselves for each adverse trait they had, the majority of participants replied they had not (70.3% to 85.7%) (Table 7.7).

Table 7.7 Reported goal setting by participants receiving tips

Have you made any weekly goals for yourself to help you follow these tips?	Number of participants receiving a tip ^a	Replies to goal setting	
		Yes	No
‘Food responsiveness’	34	9 (26.5%)	25 (73.5)
‘Emotional over-eating’	21	4 (19.0%)	17 (81.0%)
‘Satiety responsiveness’	21	3 (14.3%)	18 (85.7%)
‘Fast eating’	27	8 (29.6%)	19 (70.3%)

^a Number of participants who were following a specific tip and who responded to a questionnaire at least once

Barriers to following the tips were also obtained from the WFQ. Table 7.8 shows the barriers to following the appetitive trait tips that participants reported over the eight-week intervention period. With the exception of the tip “Have you avoided going to the

supermarket when hungry and used a shopping list?”, a substantial proportion (35.3% to 52.9%) of participants reported they did not find the ‘food responsiveness’ tips difficult to follow. Few participants reported that ‘lack of time’, and lack of ‘self-motivation’ or ‘support from others’ were barriers to following the ‘food responsiveness’ tips. The majority of participants reported that barriers to following these tips were due to ‘other reasons’. The most common of these ‘other reasons’ included ‘force of habit’ or ‘forgetting to carry them out’. Other practical barriers were: ‘My week has not involved eating with friends’; ‘When I meet friends it is to have a meal’; ‘Low calorie drinks are expensive’; and ‘Family life involves having unhealthy food around’. Very few participants didn’t believe the tips would help them. A total of eight participants (23.5%), felt they ‘did not feel ready to carry out’ the “have you tried to train yourself to resist ‘problem foods?’” tip (Table 7.8).

The majority of participants found that ‘other reasons’ were also the barriers to not following the ‘emotional over-eating’ tip (61.9%). Some of these ‘other reasons’ were ‘I did not relate to that trait in me’, ‘I forgot’, and ‘time of the month’. Three participants (14.3%) suggested they ‘didn’t find this tip difficult to follow’, and 14.3% of participants mentioned they ‘didn’t believe this tip would help’ (Table 7.8).

In the case of the ‘satiety responsiveness’ tips, apart from the “have you been eating the right portion sizes for you and storing left-overs?”, and the “have you stopped clearing your plate?” tips, the largest proportion of participants ‘did not find the tips difficult to follow’ (35.0% to 47.6%). For these tips, ‘other reasons’ were also reported to be barriers (37.5% to 59.1%). Examples of ‘other reasons’ were: ‘I don’t like to waste food’; ‘I don’t eat that much anyway’; ‘I used a smaller plate, so there is no need to leave food’; ‘I don’t eat more than I need, all my food is measured’ (Table 7.8).

Finally for the fast eating tips, approximately 70.1% of participants said they ‘didn’t find it difficult’ to follow the “have you been sitting down for your meals?” tip. For the “have you tried to eat slower than those who are eating around you?”, and the “have you been putting your fork down in between bites?” the participants mentioned as most common ‘other reasons’ for not following these tips (48.1% to 51.8%). The most common ‘other reasons’ they gave were: ‘force of habit’, or ‘forgetting to carry them out’. However, they also mentioned: ‘I don’t put my fork down between bites, because I don’t like food getting cold’ and ‘I find it very difficult to put my fork down between bites’ (Table 7.8).

Table 7.8 Barriers to following appetitive trait tips

Appetitive trait	Tips	Number of participants receiving tips ^a	Barriers to following tips n (%)							
			Did not find it difficult	Lack of time	Lack of self-motivation	Lack of support from significant others	Did not believe it would help	This week included different activities from my usual routine	Other reasons	Did not feel ready to carry out tip
	Have you avoided buying unhealthy foods and stopped having them in your home, so that you aren't tempted to eat them?	34	12 (35.3%)	0	3 (8.8%)	4 (11.8%)	0	3 (8.8%)	12 (35.3%)	N/A
Food responsiveness	Have you been able to identify specific types of food that make you want to eat and tried to avoid them	34	13 (38.2%)	0	4 (11.8%)	3 (8.8%)	1 (2.9%)	6 (17.6%)	7 (20.6%)	N/A
	When you have been with others who are eating and it is not your mealtime, have you tried having a low calorie drink?	34	14 (41.2%)	0	1 (2.9%)	0	2 (5.9%)	0	14 (44.1%)	N/A

Appetitive trait	Tips	Number of participants receiving tips ^a	Barriers to following tips n (%)							Did not feel ready to carry out tip
			Did not find it difficult	Lack of time	Lack of self-motivation	Lack of support from significant others	Did not believe it would help	This week included different activities from my usual routine	Other reasons	
	Have you suggested doing things with friends that do not involve eating?	34	16 (47.1%)	1 (2.9%)	1 (2.9%)	0	0	2 (5.9%)	14 (44.1%)	N/A
	Have you avoided going to the supermarket when hungry and used a shopping list?	33	0	3 (9.1%)	1 (3.0%)	2 (6.1%)	0	22 (66.7%)	5 (15.2%)	N/A
	Have you tried to train yourself to resist 'problem foods'?	34	18 (52.9%)	0	2 (5.9%)	2 (5.9%)	1 (2.9%)	3 (8.8%)	0	8 (23.5%)*
Emotional over-eating	Have you made a plan to comfort yourself with something other than food when you are feeling upset, annoyed or anxious?	21	3 (14.3%)	0	1 (4.8%)	0	3 (14.3%)	1 (4.8%)	13 (61.9%)	N/A

Appetitive trait	Tips	Number of participants receiving tips ^a	Barriers to following tips n (%)							Did not feel ready to carry out tip
			Did not find it difficult	Lack of time	Lack of self-motivation	Lack of support from significant others	Did not believe it would help	This week included different activities from my usual routine	Other reasons	
Satiety responsiveness	Have you stopped and paid attention to how full you feel half-way through your meal?	21	10 (47.6%)	3 (14.3%)	2 (9.5%)	0	0	0	6 (28.6%)	N/A
	Have you been eating the right portion sizes for you and storing left-overs?	16	0	2 (12.5%)	4 (25.0%)	0	0	4 (25.0%)	6 (37.5%)	N/A
	Have you tried retraining yourself to eat smaller quantities of food?	20	7 (35.0%)	0	2 (10.0%)	1 (5.0%)	1 (5.0%)	3 (15.0%)	6 (30.0%)	N/A
	Have you stopped clearing your plate?	22	3 (5.7%)	0	5 (22.7%)	0	0	1 (4.5%)	13 (59.1%)	N/A
	Have you avoided mindless eating?	22	8 (36.4%)	0	6 (27.3%)	0	0	1 (4.5%)	7 (31.8%)	N/A
Fast eating	Have you tried to eat slower than those who are eating around you?	27	6 (22.2%)	0	2 (7.5%)	0	3 (11.1%)	3 (11.1%)	13 (48.1%)	N/A
	Have you been putting your fork down in between bites?	27	6 (22.2%)	1 (3.7%)	5 (18.5%)	0	2 (7.4%)	2 (7.4%)	14 (51.8%)	N/A

Appetitive trait	Tips	Number of participants receiving tips ^a	Barriers to following tips n (%)							Did not feel ready to carry out tip
			Did not find it difficult	Lack of time	Lack of self-motivation	Lack of support from significant others	Did not believe it would help	This week included different activities from my usual routine	Other reasons	
	Have you been sitting down for your meals?	27	20 (74.1%)	3 (11.1%)	0	0	0	1 (3.7%)	3 (11.1%)	N/A

^a Number of participants who were following a specific tip and who responded to a questionnaire at least once.

* This was the only tip that included this response option.

7.7.5 Use of other weight loss programs followed alongside the tips

A total of 17/53 (32.1%) participants did not respond to the WFQ and therefore did not provide information about whether they were following other weight loss programs alongside the tips. Eleven participants (30.6%) reported they were not following any other weight loss program. Twelve participants (33.3%) described following a program-led type diet (e.g. following a weight loss group, website app, or diet book); nine participants (25%) followed a self-directed type program (e.g. following a low fat, low carbs, counting calories or in general trying to eat a healthy diet); three participants (8.3%) increased their physical activity levels; and one participant (2.8%) reported following a strict elimination-type diet (e.g. fasting, using replacement meals) (Appendix 7.6).

7.8 Discussion

I developed a novel, brief intervention that tailors weight loss tips to individuals' appetitive trait scores (the ATTI), based on their AEBQ responses, and tested this in a small population of overweight and obese adults. Initial interest in this study was low (7.7% of those contacted) and loss to follow-up was high (40%), which raises some questions about the acceptability of the intervention and/or study procedures. However, of those who completed the intervention, the majority lost weight, and just over a quarter of participants lost more than 5% of their initial body weight, which suggests the intervention holds some promise. Responses to the WFQ identified specific tips that were more difficult to follow or that participants found less helpful. Responses also identified difficulties engaging participants in the goal setting element of the intervention, and specific barriers to following the tips. This feedback could help to refine the intervention going forward.

7.8.1 Development and testing of the ATTI

The development of the ATTI followed the six steps of Wight et al.'s Quality Intervention Development (6SQuID) model (Wight et al., 2015). The theoretical basis for this study (Step 1 of the 6SQuID) comes from the finding that appetitive traits are both measurable and associated with BMI in adults (Study 3, Chapter 6). This study, replicates results from studies in children showing that 'food approach' and 'food avoidance' appetitive traits are oppositely associated with BMI in children (Carnell & Wardle, 2008a; Croker et al., 2011). Recent research has further shown that appetitive traits are linked with eating patterns in

everyday life, whereby children with high 'food responsiveness' eat more frequently, and children with low 'satiety responsiveness' eat larger quantities of food at each eating occasion (Syrad, Johnson, Wardle, & Llewellyn, 2016). Also, appetitive traits such as 'food fussiness', which have been connected with the rejection of certain foods such as vegetables, can be modified by simple repeated exposure in early childhood (Daniels et al., 2015; Howard et al., 2012), despite being highly heritable (Fildes et al., 2016). Taken together this research suggests certain appetitive traits are causally associated with weight and that tailored strategies may be effective to reduce the potential effects of appetitive traits on weight gain. 'Food responsiveness', 'satiety responsiveness', 'emotional over-eating' and 'slowness in eating' were the four appetitive traits selected for targeting. These traits were selected because they were associated with BMI in adults and were thought to be the most malleable and provide the greatest scope for modification (according to Step2 of the 6SQuID development). No tips were developed for 'hunger' and 'food fussiness' as these traits were not found to be associated with BMI in Study 3, Chapter 6. No tips were developed either for 'enjoyment of food' as it was a trait present in the majority of the participants from Sample 2, Study 3; no 'emotional under-eating' tips were developed as this trait has been mainly associated with lower weight (Wardle, Guthrie, et al., 2001).

Previously, the DEBQ has been used to examine if appetite measures are related to dieting with the purpose of weight control in patients with Type 2 diabetes. The findings suggested that matched treatments for obesity could be developed focusing on 'emotional eating' and 'external eating' (van Strein, van de Laar, et al., 2007). However, to date no studies including weight management advice targeting appetitive traits measured by the DEBQ have been published. High EAH scores, measured by laboratory assessment (Fisher & Birch, 2002), have been used to randomly allocate one of two weight management treatments to eight to 12 year old overweight and obese children. Children who were exposed to food cues, decreased their EAH post-treatment and six months post-treatment, although appetite awareness training showed no change in EAH (Boutelle et al., 2011). None of the treatments tested produced changes in BMI until the 12-month post-treatment assessment. This study was mainly concerned with how the different treatments effected EAH, and is therefore not a true example of a personalised treatment. After searching for weight loss interventions tailored to appetitive traits, I found no other results. The ATTI represents the first attempt to provide tailored weight management advice targeted at appetite trait related behaviours.

The development of the appetitive trait tips themselves (step 3 of the 6SQuID) utilised existing weight management advice developed using CBT techniques such as ‘stimulus control’ and ‘response substitution’, and other behaviour change techniques (Hartmann-Boyce et al., 2016; Michie, West, Brown, & Gainforth, 2014; Michie et al., 2011; Wardle & Johnson, 2015; Wardle et al., 2013). The tips were kept simple in order to facilitate adherence (Mata et al., 2010; Wardle et al., 2013). Simple weight loss advice has been found to be successful in other studies (Beeken et al., 2012; Lally et al., 2008).

In order to confirm willingness to participate in a tailored appetitive trait focused weight management intervention and to establish preferred methods of delivery, feasibility question responses were collected from Sample 2, in Study 3, Chapter 6. The results of the feasibility study informed the design and delivery of the intervention (Step 4 of the 6SQuID). This feasibility study revealed participants were interested in receiving simple personalised information about their appetitive behaviours, which could be used to help them manage their weight. The majority of participants in the feasibility study reported that they would like to receive intervention information via e-mail. Currently, there is a need for more cost-effective and efficacious weight loss interventions (Arem & Irwin, 2011; Jebb et al., 2011), and the internet has previously been shown to be a potentially useful method of weight management delivery, and provides an adequate medium for the development of interventions (Arem & Irwin, 2011; Webb, Joseph, Yardley, & Michie, 2010). It was therefore decided that the ATTI would be primarily delivered via e-mail.

Together Steps 1 through 4 of the 6SQuID, led to small scale testing of the ATTI (Step 5 of the 6SQuID).

7.8.2 Effects on weight

The majority of ATTI participants who completed the intervention lost weight (-1.2 kg) over the eight-week period, corresponding to a medium effect size (0.48); and just over a quarter of participants lost more than 5% of their initial body weight. Although weight loss was not the primary objective of this study, these results are promising given this was the first small scale test of the ATTI. This finding suggests the ATTI may be effective as a weight management intervention.

No statistical differences were seen in participants’ replies to the number of WFQ when analysed by weight categories. While it appeared those who lost more weight replied to more WFQ than those who didn’t lose weight or gained weight, these differences were not

significant. These results suggest that similar weekly input was made by participants independent of their weight loss, showing participants' interest in giving feedback of their experience. However, the small sample size means caution should be applied when interpreting these findings.

7.8.3 Compliance, perceived usefulness and barriers to use of the tips

Participants who completed the study provided responses throughout on their experience of the intervention. They reported using most of the tips provided to them, and found them helpful. However, certain tips were reported to be more difficult to follow and participants found some tips less helpful than others. Tips such as "if you are with others who are eating and it is not your meal time, try having a low calorie drink such as water with lime/orange, tea or coffee" ('food responsiveness'), and "suggest doing things with friends that don't involve food, like going for a walk in the park" ('food responsiveness'), were reported as not used at all by a large proportion of participants. Most participants also reported following the 'slowness in eating' tip, "put your fork/spoon down in between bites" only 'a bit of the time'. Participants also reported not relating to the 'emotional over-eating' tip. Refining the intervention might require discussing in more detail with participants the relevance to them of each tip and potential barriers of following them. For example, a possible barrier to following the "suggest doing things with friends that don't involve food, like going for a walk in the park" tip, might be that seeing friends often involves invitations to social gatherings centred around eating (e.g. birthday meals etc.), which was mentioned as a barrier by participants. Therefore, refining the intervention might not require removal of tips, but possible expansion and the generation of new tips to be adapted to individual situations (e.g. "If going out with friends involves eating, try to make healthy food choices, and don't get carried away by what your friends are eating"). In general, refining of the tips and other aspects of the intervention will be required in order to move forward with more rigorous testing of the intervention (Step 6 of the 6SQuID).

Some participants used the 'emotional over-eating' tip, however, the majority did not find this tip useful. A reason might be that only one tip was developed for the 'emotional over-eating' trait, possibly leaving the participant feeling s/he had less options to follow. CBT techniques to change emotions and negative thoughts around food, present the challenge of modifying beliefs and feelings (Wardle et al., 2013), and this may be more difficult to achieve with a simple/single tip. Adding tips related to dealing with unhelpful thoughts which surround 'emotional over-eating', could be used to improve advice related to

modifying this trait. However, emotional control training was found to be less effective in promoting behaviour change than providing stress management techniques in a systematic review of 85 internet-based studies (Webb et al., 2010). Furthermore, the majority of participants did not set themselves any goals to follow during the intervention, which could have hindered following the tips. Goal setting has been implicated as an important predictor of both weight loss and maintenance, although further studies are required (Stubbs et al., 2011). Efforts should be made to get participants more involved in following the tips. Studies report vigilant self-monitoring of eating behaviours and weight, as essential for long-term weight maintenance (Wing & Phelan, 2005; Wing, Crane, Thomas, Kumar, & Weinberg, 2010). This might be achieved by increasing the number of reminders sent. Also participants could be reminded not only to continue following the tips, but also to set themselves goals and to write down what makes them want to eat when they shouldn't.

Participants were also asked what barriers prevented them following the tips. Common replies included 'force of habit', or 'forgetting to carry them out'. Healthy habits have been shown to be acquired through repetition, and it is possible that content specific advice such as habit-based advice could be added to the appetitive trait tips (Beeken et al., 2012; Lally et al., 2008). This may help individuals to build them into their routines and help them maintain the tips over the longer term. It might also help provide the motivation needed to continue following the tips, as lack of 'self-motivation' was also mentioned as a barrier by a small proportion of the participants who followed the tips. Suggesting to participants to put a photo of themselves when they were slimmer on their fridge, might also be included in the tips as part of a strategy to improve motivation (Hartmann-Boyce et al., 2016). Other barriers identified were related to external situations such as having to have unhealthy foods around the house for the sake of other family members ('food responsiveness'), and in a small proportion of participants 'lack of time' to follow the tips (for all the tips). Barriers to following 'satiety responsiveness' tips related to already using smaller plates or portion sizes and therefore being unable to feasibly reduce meal size even further. The majority of participants found the tip recommending putting the fork down between bites difficult to implement, again reported as based on habit and not liking to eat cold food. Refining the tips to address some of these barriers would be beneficial to ensure their helpfulness and increased usage.

7.8.4 Limitations

A number of limitations are present in this study. First of all, as in Studies 2 and 3, the self-report nature of the information obtained is subject to different types of bias. Heights and weights were self-reported and under-estimates of BMI calculations are likely (Cameron & Evers, 1990), particularly at follow up. Accuracy of self-reported measures of height and weight in older age groups is known to be reduced (Kuczmarski, Kuczmarski, & Najjar, 2001). This would imply further under-estimates might be present, given nearly a quarter of the participants here were over the age of 60 years. This could have inflated the change in weight observed in the study. Participants have been known to inflate results, given the enhanced motivation to lose weight when participating in a trial (Jebb et al., 2011). This limitation could be reduced by obtaining objective measures of height and weight in future studies. Distinction between measures of fat mass and fat free mass have also been correlated with different eating behaviour traits in university students, additional recording of these measures could also provide further information about intervention weight change, not related to BMI alone (Finlayson et al., 2012).

The response rate when 'Big Panel' members were first contacted was extremely low (7.7%). First of all, it is unknown how representative of the overall overweight and obese population in the UK the 'Big Panel' is. It is also possible that members' contact details were not up-to-date and therefore these results may not be an accurate reflection of how many people received or opened the initial invitation e-mail. Therefore, it is unlikely that this is a true reflection of the level of interest in the study. Once eligible participants were identified, approximately three quarters consented to take part in the study. Possible ways to increase questionnaire responses involve the use of incentives for participation and this should be considered if the ATTI is developed for testing within a randomised control trial. Opt-out methods have also been found to be useful recruitment tools (Treweek et al., 2013).

Once the intervention started, drop-out rate was high. The lack of personal contact resulting from the internet-based delivery of the intervention may have contributed to these drop-out rates (Arem & Irwin, 2011). However, for those who persisted with the ATTI, response rates to the WFQ used to assess the compliance with the tips was high for all four traits (64% to 72%). These results reflect high participant engagement with the traits and the study itself. Some participants mentioned that they did not relate to the profiling received from their AEBQ answers, so personal contact would enable clarify discussion of

these difficulties, the tips themselves or any part of the intervention they did not feel comfortable with. Personal contact could also increase participant motivation to lose weight (Jebb et al., 2011). However, the implications of including personal contact would increase the cost of the intervention, as well as the overall costs of making the intervention itself more comprehensive. Weight loss programs which include behavioural counselling as part of their multi-component strategies, have been found to lead to effective weight loss, however, variable effectiveness has been observed across different studies (Kirk et al., 2012). The cost of implementing such studies on a larger scale can be prohibitive and therefore presents an important barrier to scalability (Coons et al., 2012). The simple, straightforward and low cost design of ATTI means it has the potential for wide scale dissemination.

Another limitation from this study is the use of participants from the 'Big Panel'. Panel members are contacted regularly to take part in research studies and weight management interventions, potentially resulting in 'over-use'. This could have a series of effects. First of all the 'Big Panel' attracts people with an interest in weight loss, and those who "know about the trials and tribulations of trying to lose weight" (Weight Concern, 2016a, 2016c). Previous weight loss attempts is a known predictor of weight loss failure (Stubbs et al., 2011; Teixeira et al., 2005). As such it may have been beneficial to have asked participants about their previous weight loss attempts, greatest weight loss achieved and past highest BMI. Secondly, members of the 'Big Panel' may have become 'fatigued' with participating in previous weight management research and interventions and therefore less willing to participate on this occasion. Recruitment from primary care settings or the general population may result in a more representative sample, allowing better generalisation to the wider population, and potentially higher response rates.

The WFQs also had their limitations. The time it took to answer the WFQ was a cause of withdrawal for two participants and may also have put others off that did not respond. It may also have acted as an effective component of the intervention for those who did complete it as a form of self-monitoring and/or because it was a reminder and additional contact for participants. These issues will need to be explored further in future studies.

Further limitations are present within this study. Although significant changes in weight were seen in the 'completers', the study was not powered to look at any differences in weight change. Participants also provided input as to whether they were following other weight loss programs alongside the tips. This was also self-reported and therefore this data

also has its limitations. Nearly a quarter of participants didn't follow any other program, and approximately one third did not provide any information on whether they had followed other recommendations. However, approximately half reported using some other form of weight loss program at the same time as they followed the tips. It is not possible to know whether the changes in weight were therefore due to the tips or accompanying weight loss methods. Also, given the small number of participants that took part in the intervention (n=53), the significant results in change in weight achieved through following the ATTI for eight weeks, should be interpreted with caution (Lancaster, Dodd, & Williamson, 2004). A further limitation was the lack of a control group, which could have been used to show the differences in weight obtained between a group that received an individualised appetitive trait profile and corresponding tips, versus another group that didn't and only received general weight loss information. However, this study could serve as the basis for a future randomised controlled trial (Step 6 of the 6SQuID: rigorous implementation of the study), which is beyond the scope of this thesis.

This study is also limited by the fact that the majority of participants were women [n=49 (92.5%)]. Gender bias is common in weight loss studies (Jebb et al., 2011; Provencher et al., 2004). It is more common for women to want to lose weight than men (Nicklas, Huskey, Davis, & Wee, 2012; Provencher et al., 2004; Wardle & Johnson, 2002), even with a greater proportion of men than women being overweight (Provencher et al., 2004). Also, men tend to show different patterns of weight loss and be more successful at losing than women, so findings associated with one gender are not necessarily possible to extrapolate to the other (Wardle & Johnson, 2015). Future studies should attempt to recruit a more proportioned sample, and any observed gender- differences could serve to better tailor future weight management interventions (Kim et al., 2015).

Finally, this study was mainly carried out to develop and test a tailored intervention based on individualised appetitive trait feedback, to determine compliance with the tips, including perceived usefulness and barriers to using the appetitive trait tips. The results obtained were mainly descriptive questionnaire-based reports of participants' experience of following the tips. No in-depth information regarding participants' experiences of following the tips can be obtained through questionnaire data. Therefore, Study 5 of this thesis will qualitatively assess participants' experiences of following ATTI.

7.8.5 Conclusions

This study involved the development of a brief intervention, ATTI, designed to provide individuals with a profile of their appetitive traits (measured by the AEBQ) and corresponding personalised weight management tips. Appetitive trait tips were developed based on CBT and behaviour change techniques that serve to help individuals modify the behavioural expression of appetitive traits. The ATTI was tested in small-scale, internet-based eight-week study. The majority of participants reported finding most of the tips helpful, with the exception of the single 'emotional over-eating' tip and two of the 'food responsiveness' tips not followed. Improvement to these and other tips are necessary if this intervention is to be taken forward. The most common barriers identified were related to 'force of habit', or 'forgetting to carry the tips out', suggesting that incorporating habit-based techniques and providing additional reminders could improve future ATTI adherence.

An average weight loss of 1.2 kg was achieved by 'completers', suggesting a small effect of the intervention on weight. This is promising, however the study was not powered to formally test effectiveness, and lack of a control group prevents generalisability of the results. The next chapter of this thesis (Study 5) will further explore participants' experiences of taking part in ATTI through in-depth qualitative interviews.

Chapter 8. Study 5: Participant experiences of a brief appetite-based weight management intervention (ATTI)²⁶

8.1 Background

The preliminary findings from Study 4 (Chapter 7), suggested that overweight and obese participants who completed an eight-week intervention including tailored appetitive trait feedback (the ATTI), followed most of the tips provided. On average, participants lost 1.2 kg over the intervention period. However, participants also reported a number of barriers to following these tips. The most common barriers described were ‘force of habit’ or ‘forgetting to carry them out’. There were also specific tips that were not followed by participants (e.g. ‘food responsiveness’ and ‘emotional over-eating’ tips). The present chapter will further explore the experiences of participants following the intervention to obtain a deeper understanding of the challenges they faced, what they liked and why. This will inform development of the intervention going forward, in line with Step 6 of the 6SQuID (Wight et al., 2015).

8.2 Aim

The aim of this study was to qualitatively explore participants’ experience of the eight-week ATTI, including barriers and facilitators to compliance.

²⁶ A version of this Study and Study 4 were accepted as an abstract to present in November 2016 at The Obesity Society in New Orleans, USA.

8.3 Methods

8.3.1 Study design

A qualitative methodology was chosen to explore participants' experiences of the ATTI from Study 5. Benefits from quantitative questionnaires such as those given to participants in the previous Chapter 7, include being able to obtain information that can be analysed to describe the general characteristics of the sample, as well as those questions asked relevant to the study. However, they are unable to capture the level of detail obtained from qualitative semi-structured interviews. This in-depth exploration enables a deeper insight into participants' involvement with the study, whether they followed the ATTI and the tips, and whether they found these to be beneficial for weight management purposes.

Semi-structured interviews were selected and considered an appropriate method for exploring participants views, experiences, beliefs and motivations of following the ATTI (Gill, Stewart, Treasure, & Chadwick, 2008). Interviews were chosen over focus groups as the choice methodology, as I was interested in individual's experiences rather than a group overview. Plus, it allowed for the interviews to be held via phone, which permitted for the remainder of the study to be carried out without any personal contact. The interviews were conducted with a sub-sample of participants at the end of the intervention period. I conducted all of the interviews in this study, having personal experience of working in clinical settings with overweight and obese patients and previous qualitative research experience.

8.3.2 Participants & recruitment

Following the ATTI, all participants (n=53) who started the intervention were contacted via e-mail (by me; CH) and invited to take part in a qualitative interview, including those who formally withdrew from the intervention (n=5). From the beginning of the study, participants were aware that they would be contacted at the end of the eight weeks to be interviewed if they had agreed to this at the time of consent (Appendix 7.5). I aimed to obtain a broad range of views and to continue interviewing until data saturation was achieved (Morse, 1995).

Participants ID number, gender (male = 'M'; female = 'F') and weight loss category (lost weight = 'LW'; same weight = 'SW'; gained weight = 'GW'); and whether they were 'engaged' or 'non-engaged' with the intervention (engaged = 'E'; non-engaged = 'NE'),

identify the participants involved in the study. Participants' weight loss categories were calculated from their self-reported weight and height at the beginning and end of the intervention (Study 4, Section 7.4.3.2, Chapter 7).

8.3.3 Interview topic guide

The interview topic guide was developed to include a series of open-ended questions (Appendix 8.1). The guide covered areas such as the participant's motivation for taking part in the study, their understanding of the information they had been given, level of agreement with the appetitive trait profiling, questions about each tip they had followed, and reasons for having been successful or not at following the tips.

The interview guide was piloted with two lay overweight individuals who had followed the tips for a week (Section 7.3.3, Chapter 7). Interviews were practiced to have minimum input and to prompt participant replies only when applicable (Oppenheim, 2003). They were carried out by phone between the months of August and September 2015 and recorded using an electronic recorder, with only myself and the participant present to ensure anonymity.

8.4 Analyses

8.4.1 Thematic analysis of interviews

The ConsOLIDated Criteria for REporting Qualitative Research (COREQ) checklist was followed throughout (Tong, Sainsbury, & Craig, 2007)(Appendix 8.2). A professional transcription company (Devon Transcription) transcribed verbatim 18 of the 21 interviews. I completed the remaining three transcriptions in order to familiarize myself with the process and the data (Braun & Clarke, 2006). To maintain anonymity, participant's ID numbers rather than names or other identifying information were used throughout the transcription process.

A thematic analysis approach was used (Braun & Clarke, 2006). Thematic analysis is independent of theory, and allows themes to emerge from the interviews using an inductive approach ('bottom up' approach) closely linked to the data. The six phases of Braun and Clark's (2006) thematic analysis were followed: familiarization, generation of codes, searching for themes, reviewing themes, defining the themes, and writing the report.

8.4.2 Coding the interviews

Initial coding of the interviews began through the familiarization process of reading and re-reading the transcripts, as well as listening to the recorded transcripts to check for transcription mistakes. All transcripts were imported into NVivo (QSR International Pty Ltd, 2012), a platform used with unstructured data to facilitate coding and analysis. Initial coding was carried out using five interviews to provide examples of the generated codes. Amending of the codes was then carried out with a group of researchers (RJB), (AF) and (FJ), and a final list of codes was agreed upon. All transcripts were then coded by selecting the text which captured the intended context/quote. Initially, one quote in the text could be assigned to different codes. All quotes were then revisited, until they were assigned to a single code. A total of five transcripts were selected for coding comparison using kappa for inter-rater agreement by a second researcher.

8.4.3 Data saturation

Interviews were carried out until saturation of themes in the data was reached. Saturation was obtained after 18 interviews, however I carried out three further interviews to ensure no new information was obtained and to increase the richness of the data through detailed description (Morse, 1995).

8.4.4 Themes

After coding in NVivo had taken place, codes were grouped into themes that related to the experience of the intervention. Additional themes arose from the data but were excluded from the current analyses as they did not contribute to the aim of this study. For example, some participants discussed at length the benefits and downfalls of different types of weight loss programs, not in relation to this intervention. Other participants described what meanings they gave to food. Themes were checked across the sample to ensure they could be applied to those interviewed.

8.5 Ethical approval

Ethical approval was obtained from the UCL Research Ethics Committee; Project ID number 4378/003 (Appendix 7.8).

8.6 Results

8.6.1 Participants

A total of 21 out of 32 (65.6%) 'completers' from the ATTI study agreed to take part in semi-structured telephone interviews. Appendix 8.3 shows a detailed list of participants' characteristics. The interviews lasted between 20 to 48 minutes (39 minutes on average). The participants who took part in the semi-structured interviews did not differ from the overall sample in terms of age, gender, BMI category, ethnicity, marital status, level of education, employment, or living arrangements. There was no significant difference by weight categories between those who were interviewed and not interviewed ($\chi^2=3.410$; $p=0.270$). Those interviewed were significantly more likely to have replied to '5 to 8 WFQ' 14/21 (66.7%), than those not interviewed ('5 to 8 WFQ' 2/21 [33.3%]) ($\chi^2=12.166$; $p=0.001$).

Of those interviewed, four participants reported following the tips for a short period of time (approximately two weeks overall), but still liked the study, though two did not relate to the tips (Participant 35, F, LW, and Participant 37, F, LW). Two participants did not like the intervention (Participant 16, M, SW, and Participant 8, F, LW, who followed the intervention for four to five weeks). Finally, one participant mentioned she did not follow the tips because she was not 'ready to follow them' (Participant 4, F, GW). These five participants were classified as 'non-engaged' participants (NE), and their views are expressed in the results (See section 8.3.2).

8.6.2 Themes

Three main themes emerged from the data with the influence of their own sub-themes:

- (1) Experience of the intervention: (i) Engaging with the tips and materials; (ii) The importance of tailoring; (iii) Focus on drivers of behaviour change; (iv) Too low intensity: a desire for more information; and, (v) The role of personal contact;
- (2) Consequences of the intervention: (i) Increased self-awareness; (ii) Behaviour change; (iii) Physical consequences;
- (3) Barriers and facilitators to adherence: (i) Routines and habits; and, (ii) Social networks.

Themes were identified from thematic analysis of the semi-structured interviews. They are detailed below, and illustrative quotes are included where appropriate with participants' ID number, gender, weight loss category and level of engagement provided in brackets to add context to the quotes. Very few differences were seen between participants' responses by whether they had lost weight or not lost weight during the intervention. When differences by weight were seen they are reported. More differences were seen between participants who engaged with the intervention (n=16) vs. those who did not (n=5), and these are highlighted below.

8.6.2.1 Experience of the intervention

The first theme was related to the experience of the ATTI. This theme was influenced by five key sub-themes: (i) Engaging with the tips and materials; (ii) The importance of tailoring; (iii) Focus on drivers of behaviour change; (iv) Too low intensity: a desire for more information; and, (v) The role of personal contact.

Engaging with the tips and materials

Engaged participants reported that getting involved with the study was in part because the tips were very clear, simple and easy to understand: *"They're very nicely laid out as well and they're very, like, colourful and they grab your attention. That's what I noticed about them first of all."* (Participant 10, F, LW, E). Although some of these participants described being initially put off because of concerns that the tips would be difficult to implement, they discussed how things became clearer upon engaging with the material: *"At first, it was quite difficult to follow. I looked at it and I thought, ooh that's going to be really hard, but as I worked my way through it and kept rereading it, it got easier and easier"* (Participant 13, F, SW, E).

Delivery of the tips via e-mail was seen as a facilitator to initial engagement for all participants because it was not too intrusive to their daily life. The pdf format in which they were presented, made them accessible on different devices, such as computer screens, tablets, and phones. However, suggestions for modification of the delivery of the tips were also made. They recommended receiving daily tips or reminders via text or within an app to promote engagement over the longer term: *"I've seen apps where these kind of things pop up at regular intervals during the day. So that kind of tends to keep it more focused."* (Participant 26, F, LW, E); and *"Or just a text sort of thing"* (Participant 35, F, LW, NE).

Engaged participants relied on the weekly reminders as well as the WFQ to keep them motivated. They liked the frequency with which both were sent, although suggestions were made to increase the reminders to twice a week, and decrease the time-consuming WFQ to possibly every couple of weeks in a Survey Monkey format, to encourage a faster response and delivery to fit into their schedule. This was also recommended by those not engaged. The WFQ served as a reminder and a tool for reinforcement, helping participants to maintain focus. They made participants think twice about what they were doing, as well as prompting them to try to follow the tips: *“The reporting back on Tuesday is absolutely crucial”* (Participant 6, M, LW, E). This was also the case for those participants who did not engage with the tips for the duration of the intervention: *“So in a small way, it would give me a retrospective on the previous week going, “Yes, I didn’t do that, did I? Damn. Okay.”* (Participant 16, M, SW, NE). The majority of participants did not set themselves any goals, either because they had previously set goals which they already followed, or because they felt these didn’t work: *“I find it’s a real negative actually, to set goals at all.”* (Participant 2, F, LW, E); or they just set themselves an initial goal to keep following the tips without writing anything down: *“I’ve not really set myself any goals, just to keep trying really”* (Participant 10, F, LW, E). Participants who engaged with the study also had difficulties remembering to use the tips: *“I’d forget for a few days and then think so I haven’t done it, and I’d still... that disturbs me as a person, but it was fine to do it like that.”* (Participant 23, F, GW, E).

The importance of tailoring

The fact that the tips were personalised, or tailored, was considered by most of the participants, to be one of the key strengths of the intervention. The personalisation motivated engaged participants to follow the tips, even when the tips did not present them with new information: *“I think I knew these things about me, but it’s the first time I’ve seen them providing a response and filling out a questionnaire”* (Participant 26, F, LW, E). The individual tailoring using the AEBQ was also seen as a novel tool: *“Some of it is reinforcing advice that I’ve heard before. But it’s nice how it’s all collated into one place and it’s tailored for me so that I’ve got it all there to hand rather than having to wade through pages and pages of things that aren’t even related to me.”* (Participant 6, M, LW, E).

Some of the engaged participants felt that the tailoring of the tips was fundamental to their success: *“It’s incomparable, to be honest with you, because it’s so personal and it’s so spot on. And what it has done is it’s asked me first of all what my particular areas of trouble are.*

And that is absolutely vital, in my opinion” (Participant 28, F, LW, E). The information on appetitive traits in the pdf allowed participants to recognise their personal appetitive profile, which they had previously been unaware of: “I wouldn’t have registered the ‘food responsiveness’ consciously without it being pointed out and explained” (Participant 41, F, LW, E). And those engaged in the study felt that knowing that there were some traits they didn’t have and therefore tips they did not need to follow was very comforting: “... so not only to know the things that I needed to work on, but things that I... like I said before, that I don’t need to worry about so much, that I kind of think, ‘Actually, that’s really useful that I don’t have to... oh goodie, I already know when I’m full or not.’ So I found that really, kind of... the fact that it was tailored was really helpful. That’s probably the biggest thing, to know that not everybody would be like that, if that makes sense?” (Participant 46, F, LW, E).

However, not all participants had such a positive experience. Several participants did not identify with a particular trait. They would have liked to have seen the results from their AEBQ scores: *“I don’t really have much of a problem with emotional eating, I don’t think to myself, oh I’m getting all screwed up and I must eat something. It just doesn’t happen. It will be interesting to see what I’d answered on that one, actually.” (Participant 6, M, LW, E);* or they simply did not agree with the AEBQ scores: *“What put me off a little was the tips sheet clearly had come to a conclusion based on my questionnaire, I would have liked to have seen more... almost a review of the tip sheet – ‘Because you said this, this and this, we’ve come to this conclusion’.” (Participant 16, M, SW, NE). Not relating to the traits caused some participants not to engage with the study: “I didn’t feel they were as personalised as maybe I could have done with. I couldn’t identify with some of the descriptions, therefore it was much harder for me to...{follow}” (Participant 8, F, LW, NE);* and *“Have a plan for another way to comfort yourself that doesn’t involve food’. Okay. We can all have a plan, and I’ve had plans for years. And then when it got on to the tips, as I say, they are not me, and they don’t feel like they will work.” (Participant 16, M, SW, NE).*

Focus on drivers of behaviour

Participants acknowledged following many diets throughout their lifetime. However, those who engaged with the tips compared the ATTI positively to other weight loss programmes in terms of the focus being on what might be driving certain behaviours, as opposed to simply asking participants to change these behaviours: *“most things say eat less and don’t eat this and do eat that and then, you know, more exercise, but they don’t spend quite so much time thinking about how other people affect your weight loss, which I think this does,*

it makes you think a little bit more" (Participant 2, F, LW, E). As a consequence, participants felt the tips helped them to retrain their behaviour, which was felt to be beneficial in terms of maintaining any changes made over the longer term: *"Well, I think it is helping because it is retraining me, and a lot of the other programs don't do that. They're all for weight loss, and then as soon as you stop the programme, you put it back on again. Whereas what you've got to do is you've got to re-train yourself to eat healthily and to not do the things that you're doing wrong"* (Participant 18, F, LW, E). One non-engaged participant understood how the intervention was trying to motivate people: *"I have found it interesting, and I'm interested to see a different approach rather than everybody has to eat cottage cheese and run four miles a day, or whatever. So I can see it's trying to find how to motivate people."* (Participant 35, F, LW, NE).

Too low intensity: A desire for more information

For those participants who did not engage with the intervention, the study did not sufficiently motivate them to become engaged with the study: *"So actually, it didn't bother me much. And I probably needed it to bother me more"* (Participant 16, M, SW, NE). A few non-engaged participants described feeling bored with having to try just another program to lose weight, and one participant felt the tips were more for weight maintenance (rather than weight loss): *"I think some of your tips and stuff would actually be better just for weight management, from my personal perspective."* (Participant 4, F, GW, NE). The tips were perceived to be too low intensity and this made them easy to forget: *"But quite often, I have to say, I just completely forgot about them"* (Participant 37, F, LW, NE). Non-engaged participants felt the tips were not focused enough and suggested changes to improve the interventions, such as having specific tips to follow every week: *"And it was a bit... given it's a tip sheet, I think it was too focused on giving me the background rather than saying, 'So here's your tips for this week, do these three things,' for example."* (Participant 16, M, SW, NE). One participant who did engage with the intervention and lost weight, also perceived the tips to be too low intensity to have an impact on their own: *"Yes, I think you'd have to use it..{in combination with another weight loss method} I don't think... because you'd have to have a certain amount of knowledge about what to eat, or I think have to be following some form of food management, if you like to call it. You couldn't just eat the whole spectrum, even if you were following these tips, it wouldn't work. So you have to use it in conjunction with some form of diet or other."* (Participant 2, F, LW, E).

All participants felt that the 'emotional over-eating' tip did not contain enough information to help them follow this tip. Advice covered the few emotions listed in the AEBQ questionnaire, but it did not extend to other emotions that participants felt triggered their 'emotional over-eating': *"It says 'sad or worried'. I mean, some people can eat when they are happy, or me when I'm stressed, sort of thing, but you wouldn't recognise it really unless it was actually written down."* (Participant 13, F, SW, E). And participants criticised the inclusion of a single tip related to 'emotional over-eating' and suggested having more tips to help them with this trait: *"They were quite sparse though {the 'emotional over-eating' tip}, compared to the other, and they didn't give any new information."* (Participant 35, F, LW, NE).

The website links included in the tips were found to be very useful for some of the engaged participants, though not everybody accessed these resources. There were, however, suggestions to add additional links including sites providing information specifically on appetitive traits, in order to provide a reliable and trustworthy source of relevant on-line information. Engaged participants did feel that more information on healthy eating, such as a list of further reading and website references might be useful for increasing the impact of the intervention: *"Yes, maybe a guideline to a weekly what you should eat during the day sort of thing. Maybe a guideline on that would be helpful for people that weren't following a weight loss programme."* (Participant 47, F, LW, E). They also suggested including more information on healthy snacks and healthy food options.

The role of personal contact

Most participants mentioned that direct personal contact could facilitate adherence with the intervention, while counteracting feelings of loneliness and isolation of trying to lose weight: *"I think what's useful is finding that somebody other than you cares. I think it's very lonely, being overweight."* (Participant 8, F, LW, NE). While some of the engaged participants felt that the internet-based contact was sufficient to keep them following the tips, others felt that more personal contact was necessary. It was suggested that professional support and personal contact would have been particularly beneficial during the initial profiling stage, at the beginning of the intervention: *"I think, as I said earlier, a beginning meeting and then going through this with the tips would be just amazing."* (Participant 23, F, GW, E). Participants who did not engage with the intervention also felt the need for more personal contact: *"I think if I'd have had this conversation, even via Skype, at the beginning, yeah, I would have been able to explain a little more; it would have*

become a little more personal." (Participant 8, F, LW, NE). Contact with a health professional, would have been beneficial and thought to introduce an element of further accountability: *"Maybe it might have been nice to have had some telephone contact"* (Participant 30, F, LW, E); *"Yes, I think so {would like more personal contact}. I do think that you have to be accountable to someone else somewhere along the line"* (Participant 2, F, LW, E).

8.6.2.2 Consequences of the intervention

This second theme comprised three sub-themes: (i) Increased self-awareness; (ii) Behaviour change; (iii) Physical consequences.

Increased self-awareness

Participants who engaged in the study discussed how the tips helped them to become more self-aware of their behaviours and traits: *"I wouldn't have registered the food responsiveness consciously without it being pointed out and explained."* (Participant 41, F, LW, E). A heightened understanding of their traits and their behavioural consequences increased their self-efficacy for making changes: *"I think the most significant thing is just the knowledge that I'm more responsive. So I just think twice about everything and I know that it isn't a genuine want for something."* (Participant 17, F, LW, E); and answering the AEBQ helped them achieve this: *"I've been trying to lose weight for a long time. And by doing the survey, it came up with some things that maybe I wasn't aware of."* (Participant 18, F, LW, E). Engaged participants discussed how this increased awareness also helped them to remain focused on their personal goals: *"Well, it helped me to focus on what I was trying to do. I didn't always go through it step by step, like your slides, but certainly I kept the gist of it to the top of my mind a lot of the time so that whenever I did think about eating, I actually thought about these points, and that meant, or does mean, that when I eat I am more aware of what I eat and why I'm eating it, and what I can expect from eating it, and that helps."* (Participant 48, F, LW, E).

The tips provided the engaged participants with tools to feel more prepared and confident: *"I don't know if confidence is the right word to use. I feel better armed, better equipped. Yes, that's it. I feel better equipped."* (Participant 28, F, LW, E). However, this self-awareness was also seen in those who did not engage in the intervention: *"I feel different in myself for the slightly increased level of consciousness about me and my relationship to food."* (Participant 16, M, SW, NE).

Behaviour change

Participants who engaged with the study described how the intervention had motivated them to make changes to their dietary and physical activity behaviours. For example, they described finding other things to do, instead of using food as a way to comfort themselves, as was suggested for the 'emotional over-eating' tip: *"I would try and do something nice for myself, like either file my nails, paint my toes, toenails, have a nice shower with nice smelly things, or something"* (Participant 25, F, SW, E).

Specific tips emerged as being difficult to follow by those engaged in the study. The 'satiety responsiveness' tip on not clearing the plate or eating smaller quantities was difficult for some participants, because they felt that they were already careful to eat very little or about the right amount. Participants also found it very difficult to not clear their plate because of perceptions about wasting food, although some did achieve changes related to this behaviour: *"When I was a child, it was always that, 'No, you empty your plate, there are people in this world that are starving,' and I was brought up with that mindset, anyway. So that's a very difficult one to get out of. But in saying that, I don't waste food now, so I don't have that problem, because I only buy what I'm going to use and I make sure it's all used."* (Participant 28, F, LW, E).

Some participants who followed the intervention failed to identify with the tips within a given trait, which made for difficulties in behaviour change. For example, there were participants who did not feel they had a problem with seeing other people eat, or that social eating situations either did not apply or were not a problem for them: *"But we don't often have friends... we don't really have people come around that often, so that's not a problem. So it's only family mostly who actually come"* (Participant 2, F, LW, E). One of the most difficult tips to follow in the 'slowness in eating' category was the advice to put your fork down between bites. Participants complained that this behaviour led to their food getting cold: *"I have tried, but I don't like cold food. That's the other thing. I like to eat it before it gets cold"* (Participant 9, F, SW, E).

Physical consequences

Those participants who lost weight were motivated by this weight loss: *"I'm feeling more energetic, I'm feeling good when people have noticed. For example, I've been told that my thighs are smaller, that I've lost a bit of weight."* (Participant 41, F, LW, E). Participants who engaged in the intervention also described changes they experienced as a consequence of following the study, which extended beyond weight loss: *"it's actually had a massive impact*

on my training as well, because now my nutrition is so much better because I'm not having things that aren't nutritious anymore, because I'm conscious of the fact that I don't want to be eating a bit of chocolate or some crisps or everything." (Participant 17, F, LW, E).

8.6.2.3 Barriers and facilitators to adherence

The last theme that emerged related to barriers and facilitators to adherence, which was underlined by two sub-themes: (i) Routines and habits; and, (ii) social networks.

Routines and habits

Keeping to routines helped those participants who engaged with the intervention to follow the tips: *"When you are in a routine it's a lot easier, but when you are out of routine or with other people who don't seem to care what they eat or whatever, then it gets a bit harder."* (Participant 9, F, SW, E). In order to fit the tips into their routines, participants either made changes to the tips to fit with their lifestyles or suggested how the tips could be improved to increase their chances of success. For example, doing on-line food shopping helped some participants avoid problems with 'food responsiveness' and temptation experienced when walking along the aisles of a grocery store: *"Because I do an on-line shop, so I don't go shopping, so that makes it slightly easier because then you are not seeing the food, and I tend to buy the favourites each week, so I'm not looking down the sweetie aisle or biscuit aisle, or whatever."* (Participant 25, F, SW, E). For some participants, wrapping a biscuit in cling film, a tip recommended to train participants in countering their 'food responsiveness', felt the concept of self-training was abstract and vague: *"I was supposed to wrap something up in Clingfilm and leave it by my desk. That's possibly what it was that's put me off doing that, was I just kind of thought oh I can't see that working."* (Participant 4, F, GW, NE). However, engaged participants reported leaving out an entire unopened packet, and attempting not to open it, or simply decided keeping problem foods out of sight, essentially finding a different way to include the tips into their routines.

The occurrence of unscheduled or unplanned events disrupted routine and became a barrier to success in engaged participants: *"Things that are unplanned, I've not anticipated really {prevent me from following the tips}."* (Participant 48, F, LW, E). Planning was difficult particularly in the context of being able to find time to fit everything into the day: *"Yes, that's the biggest thing for me is the time factor"* (Participant 25, F, SW, E); this was also reported by those who did not engage in the study. And even a routine such as work sometimes kept participants from over-eating because it was a distraction, but for others unplanned events at work was the cause of further stress: *"You know like at work they just*

bring in cakes and things, and you think [sighs] and that's when I just succumbed and just thought, ooh I'm starving, I'm going to have one of these" (Participant 13, F, SW, E).

Participants found that occasions that broke routines such as family visits, would throw off people's plans: *"my wife loves baking, and she does tend to bake when the family visits, and things that don't normally appear in our menu suddenly appear and they are quite attractive and very tempting"* (Participant 6, M, LW, E). Participants that did not engage with the intervention mentioned that going away on holiday or going out on weekends was one of the main reasons that prevented them from following the tips: *"I think, to be honest, a lot of it is just I've had a lot of weekends away and I'm not in control of what I can eat and that then, you know, it just makes life so difficult when you are just trying to be controlled, really."* (Participant 4, F, GW, NE). After these events, resuming the tips was difficult.

Participants wanted to incorporate the tips into their habitual behaviours, so that they could keep reinforcing the information: *"Yes, and it makes me maintain it as well, because I don't think it's got into a habit where I'd be able to do it without thinking about it, so I need to keep on top of it and keep bringing it to the front of my mind to make sure I'm still doing it, like a check."* (Participant 10, F, LW, E). Overall participants who followed the tips seemed to be able to incorporate them into their routines. However participants also reported that existing 'bad' habits sometimes acted as a barrier to adherence: *"I do have a lot of problems with habits. Like if I go to the garage, I just buy a chocolate or something like that. I think I'm a bit lazy at times."* (Participant 10, F, LW, E). Similarly: *"Just, again, not thinking, just going straight for it."* (Participant 46, F, LW, E). And this was the case for non-engaged participants also: *"My habit of eating fast"* (Participant 16, M, SW, NE).

Social networks

Engaged participants mentioned a need to have support from their family and friends to help them make changes: *"{I'd say to my daughter} Remind me to eat slower."* (Participant 25, F, SW, E). Participants suggested that advice about building a support network to encourage adherence could become part of the tips themselves: *"I got my husband involved, I got a few friends involved ... and they provided a support network, encouraging me to wait or to eat healthy instead"* (Participant 41, F, LW, E). Other people's examples of successful behaviour change were also reported as important facilitators, such as previous weight loss from spouses or friends: *"my husband has lost weight recently and changed a lot of things about his diet, so he will be more in tune with my goals"* (Participant 9, F, SW, E); or mimicking of other people's good behaviour: *"My husband, he eats really slow, so I*

was trying to match his pace.” (Participant 13, F, SW, E). Participants who did not engaged in the intervention made suggestions of different ways they could be supported by others to help them make changes: *“Having someone else clear away is a big one, but you didn't really touch on that.... And the other one I would have is have somebody in the kitchen while you're preparing the food, because I don't pick anywhere near as much when other people are there.”* (Participant 8, F, LW, NE).

One of the main barriers to following the tips were related to personal or family health issues. An example from one participant was having disabled children, who required time and attention, creating a stressful environment in which to follow a personal weight loss intervention. Other family issues also created stressful situations, such as having teenagers around the house who ate different foods or having other family members who were not on a diet were also a strain: *“I think a difficult one tends to be the buying and having healthy foods in the home, because there's not always going to be everyone in the home wanting to keep an eye or be on a diet or watch their weight.”* (Participant 41, F, LW, E). People who are more susceptible to eating in the presence of others might experience this barrier more often.

Access to a newsletter, and support through on-line forums were proposed in order to create a weight management community and provide a space to discuss personal issues by both engaged and non-engaged participants: *“I suppose it would always be interesting to access a newsletter just so that you know where you fit into the bigger picture, I suppose.”* (Participant 48, F, LW, E); *“you could possibly look at a forums and things like that.”* (Participant 8, F, LW, NE).

8.7 Discussion

This study built on findings from Study 4, Chapter 7, with the aim of exploring participants' experiences of taking part in a brief Appetitive Trait Tailored Intervention (ATTI). Three themes and their sub-themes emerged from the interviews. First, the experience of the intervention revealed five sub-themes: Engaging with the tips and materials; the importance of tailoring; focus on drivers of behaviour change; too low intensity: a desire for more information; and, the role of personal contact. The second theme, consequences of the intervention included three sub-themes: Increased self-awareness; behaviour change; and physical consequences. Finally, two sub-themes emerged from the third theme

barriers and facilitators to adherence, which related to routines and habits and social networks. Overall 21 interviews were obtained, 16 from participants who engaged with the intervention, and five interviews from participants who engaged only very briefly with the intervention. The findings from this study yield useful recommendations for refining the intervention before moving forward with rigorous implementation of the study (step six steps of Wight et al.'s 6SQuID steps) (Wight et al., 2015).

8.7.1 Experience of the intervention

Overall, differences between engaged and non-engaged participants' experiences of following the ATTI and using the tips were seen. Engaged participants found the intervention to be clear and easy to understand. These results are in line with previous studies that have shown that weight loss intervention material that is simple and easy to deliver, can be a beneficial way to obtain significant weight loss (Lally et al., 2008), although the ATTI differs in that the simple information was delivered via the internet. Engaged participants also relied on the WFQ as reminders, they saw them as motivational tools that helped as reinforcement, helping them to maintain focus, although suggestions were made to change the format and frequency of their delivery. However, they still had difficulties remembering to follow the tips. Recommendations to receive daily tips via text or within an app were proposed to help with sustaining engagement, and serve as more frequent reminders. A systematic review of 85 internet-based health interventions showed that those providing supplementary delivery modes such as text-messaging were more effective at promoting health behaviour change (Webb et al., 2010). Webb et al., found that overall, internet-based weight management programmes had a small effect on weight-related behaviour change, providing a suitable medium for delivery of an intervention, however text messaging enhanced the effectiveness of such interventions. This could therefore be beneficial to include in taking the ATTI forward.

Engaged participants also found the personalization and tailored aspects of the tips motivating and fundamental to their success, and even non-engaged participants found the ATTI provided information about their own traits that they didn't know. A big part of weight loss interventions is related to motivation (Dalle Grave et al., 2013; Metzgar, Preston, Miller, & Nickols-Richardson, 2014; Stead et al., 2015). For those engaged participants who did not have unfavourable scores for all the traits, it was comforting to know that they did not have to follow all of the tips. Tailoring of diets to specific traits and personal characteristics (which could include, age, gender, or even factors such as weight

loss expectations, or lifestyles) is a known predictor of success at weight loss and weight loss maintenance (Teixeira et al., 2005) (as discussed in Chapter 1). Personal tailoring of weight management information, alongside the provision of feedback regarding genetic risk of obesity was viewed as beneficial among 'higher-risk' and 'average-risk' students and among overweight and obese adults (Meisel & Wardle, 2014a). Results from other qualitative studies also suggest that adapting weight loss interventions to participants' differing characteristics is likely to improve outcomes (Stead et al., 2015). To further assess the value of tailoring to specific traits, future studies could explore if greater success is achieved with the ATTI compared with a non-tailored intervention providing similar information for weight management.

This study shows that participants felt that the ATTI compared favourably to other weight loss programs, and in particular it allowed them to consider their own behaviours and start to retrain them. This suggests that the development of the tips based on CBT adapted from 'Shape-Up' (Study 4, Section 7.3.3) was partly successful and in line with the aim to provide skills to control over-eating tendencies (Wardle & Johnson, 2015; Wardle et al., 2013). However, some participants felt that they needed the intervention to be more intensive. These participants seemed to get bored with having to try just another program to lose weight, and one participant felt the tips were more for weight maintenance purposes. In a systematic review of 23 studies, self-help interventions (which are self-directed and do not require professional input to deliver) produced significant, albeit modest, weight losses at 6 months when compared with minimal interventions (Hartmann-Boyce et al., 2015). However, this level of input may not be sufficient for everyone and so the ATTI could potentially be used alongside other programs, as was suggested by one participant. More intense versions of the ATTI could also be tested, for example providing participants with more support, which also fits with the desire for increased personal contact from a health professional.

The recommendation to provide initial contact after the AEBQ profiling suggests this should be taken into consideration when continuing with the ATTI in future evaluations. Personal contact with a health professional is known to increase weight loss success and previous qualitative studies have shown that having some form of nutritional education for weight maintenance, was necessary to making healthier choices (Jebb et al., 2011; Metzgar et al., 2014). Personal contact also provides a form of accountability which is known to increase motivation (Stead et al., 2015). Both engaged and non-engaged participants in this study

mentioned that some form of personal contact made them feel more accountable, thereby increasing their motivation to apply the tips.

Other ways of providing more support would be to include web links to more information, for example recipes and healthy food choices, and a webpage with more explicit information on appetitive traits, something that participants suggested. These results are in line with replies to the feasibility study carried in Study 4, Section 7.3.2, where 46.5% of participants reported that they would be interested in receiving information about 'healthy food options'. However, healthy food options were not included in the tips, as they were thought to be related mostly to 'enjoyment of food'. Given that the majority of participants have high scores of 'enjoyment of food' (mean 4.00 ± 0.74), no tips were developed for this trait, based on the steps for quality intervention development (Wight et al., 2015), there seemed to provide a limited scope for change. However, consideration to participants' desire for this input should be taken, when taking the ATTI into future research.

In some cases, participants reported that they found specific tips difficult. In particular, the 'emotional over-eating' tip was found to be the least informative and was least endorsed by the participants. Participants mentioned that different types of emotions set them off. However, the ATTI only includes feeling 'upset', 'worried', 'anxious', 'annoyed' or 'angry', and participants mentioned including other emotions as part of the tips such as happy, or even being stressed or tired. These findings were in line with results from the quantitative analysis in Study 4, Chapter 7. Given that this single tip was based on 'cognitive restructuring' techniques when it was developed (Study 4, Section 7.3.3, Chapter 7), it may require the inclusion of additional techniques to influence challenging thought processes when refining the intervention and moving forward in future implementation of the intervention (Dalle Grave et al., 2013; Wardle et al., 2013; Wight et al., 2015). Stress management was the behaviour change technique which was associated with the greatest change in behaviour in the previously mentioned systematic review of internet-based interventions (Webb et al., 2010). Given only a few studies used it, its use should be treated with caution, but it was seen to be more effective than emotional control training. The possible use of stress management strategies to help with 'emotional over-eating' should be considered in future work with the ATTI.

8.7.2 Consequences of the intervention

Engaged participants showed an increased self-awareness of their behaviour and their traits, which led to an increase in their self-efficacy for making changes. Self-efficacy relates to participants' beliefs about being able to make changes to their behaviour and is a known predictor of weight loss success (Dalle Grave et al., 2013; Stubbs et al., 2011). Engaged participants in this study described how the ATTI helped them to feel motivated about making changes to their behaviours. It provides useful information that allowed participants to feel more confident in their capacity to change their behaviours. Even when some of the tips were difficult to follow due to persistent ingrained behaviour such as avoiding clearing their plate ('satiety responsiveness' tip), behaviour change was reported to be achieved by some. Literature shows that for changes to be made, participants need to feel confident to initiate new behaviours (Schwarzer, 2008). This study showed that changes in behaviour had an effect on weight, as well as other positive physical consequences.

In line with Study 4, when asked about the goal setting sheet in the ATTI, the majority of participants did not set any goals for themselves. They had either previously set goals prior to the intervention, or had set themselves an initial goal to follow the tips throughout the eight weeks. Self-management strategies, such as goal setting and self-monitoring, have been seen to be among the most commonly recommended strategies in self-help studies (Hartmann-Boyce et al., 2015), however, they do not appear to have any effect on behaviour change as part of internet-based health interventions (Webb et al., 2010). Testing to see if goal-setting is effective for use in the ATTI might need the use of a control group with and without advice to set goals, to assess differences.

8.7.3 Barriers and facilitators to adherence

Results from this study revealed that keeping to routines was an important facilitator of adherence to the intervention. These results are in line with previous qualitative studies which reveal that when changes to diets and physical activity are incorporated into participants' daily routines, they are more likely to be maintained (Lally, Wardle, & Gardner, 2011; Stead et al., 2015). When the tips did not fit into their daily lives, engaged participants made adaptations to incorporate them. Suggestions for on-line shopping or different ways to carry out 'resistance training' instead of using cling film to wrap a problem foods were made, which could in future be developed. The development of a 'bank' of different tips could be developed for future testing of the ATTI, this could provide different

tip options for all the traits. For example, the development of different 'food responsiveness' tip options on the use of cling film as 'resistance training', or different activity options when going out with friends to avoid over-eating, which were mentioned as tips that engaged participants did not relate to. Other tip suggestions could include different ways to reduce portion sizes or eating more slowly, which participants found particularly difficult to follow.

Unplanned events and disrupted routines were barriers to following the tips in engaged participants and in non-engaged participants' holidays and weekends away were particular problems. Documented experiences of ten participants who followed the Top Ten Tips in an weight loss intervention for an eight week period, revealed that preparatory planning was needed to avoid past behaviours after a cognitive awareness of previous ingrained habits (Lally et al., 2008; Lally & Gardner, 2011). Participants in this study suggested that they would be interested in making the tips into habitual behaviours. Support for planning to form positive habits could then be included in this intervention in future, given that planning is an important part of initiating habit formation (Lally et al., 2011). Participants believed that changing their habits was difficult, in light of patterns that were very established. They talked about ingrained habits and saw these as barriers to change, although participants mentioned that the tips helped them to change their self-awareness. On the other hand, finding ways to integrate the tips into existing routines was identified as a useful way to support the use of the tips. This again fits with habit-formation theory where repetition in a consistent context could help behaviours to become automatic (Beeken et al., 2012).

All participants reported social networks as both facilitators and barriers to adherence to the tips, in line with previous research (Dalle Grave et al., 2013). Significant evidence exists for social support in the form of friends, family members or co-workers, as an essential element of weight loss and weight management programmes (Alm et al., 2008; Metzgar et al., 2014; Stead et al., 2015; Thomas et al., 2014). Whilst encouragement and support from family was a facilitator of behaviour change for some, family was also a barrier to adherence. Results from the interviews support the findings from Study 4, where participants mentioned lack of support from significant others as a common barrier to following the tips (Section 7.7.4, Chapter 7). The ATTI could provide suggestions of different ways that they could enlist support from family and friends, as some participants suggested that this should be included in the tips. Both engaged and non-engaged

participants suggested including access to a newsletter, and support through on-line forums in order to create a weight management community and provide a space to discuss personal issues. This has been shown to moderately support behaviour change (Webb et al., 2010). Again, these suggestions should be considered in any future development of the ATTI.

8.7.4 Limitations

This study has a number of limitations. Firstly, attempts to contact participants who did not finish the ATTI or who failed to provide their final weight were largely unsuccessful, so all of those interviewed had some level of engagement with the ATTI. Better insight might have been gained into barriers to adherence from those who did not complete the intervention. Significant differences were seen between those interviewed and the number of replies to WFQ. Those interviewed were significantly more likely to have replied to '5 to 8 WFQ' 14/21 (66.7%), than those not interviewed ('5 to 8 WFQ' 2/21 [33.3%]). These results possibly show differences in engagement with the intervention. Also, perhaps some people didn't feel the need to fill in the WFQ every week, but still engaged with the intervention.

Information was obtained from five participants who were considered not to have engaged with the ATTI. Four interviewed participants reported following the tips for approximately two weeks overall. Two of those four participants were grouped into those non-engaged, however they still liked the ATTI and related to the tips, and lost weight, probably due to following other forms of weight management. Another two participants did not particularly like the intervention, one of them maintained their weight and the other lost weight (but followed the tips for a slightly longer five-week period). Only one participant stopped following the tips because she felt she was not ready to follow them and she gained weight. Results from more participants who did not follow the tips, weren't engaged or did not finish the intervention, could have enriched the results obtained from the interviews.

A further limitation surrounds information on weight and weight management, which can be extremely sensitive in nature, potentially leading to social desirability bias occurring in the interviews (Cameron & Evers, 1990; Johnson et al., 2012). However, all participants invited to take part in the interview were told that even if they hadn't followed the intervention, or the tips, their thoughts would be welcome, even if the input was negative. Thirdly, although no personal support was given to the participants throughout the ATTI, a

few participants mentioned that they felt supported by an intervention. This could have increased the liking towards the ATTI.

The majority of participants interviewed were women (90.5%) which is also a limitation of the study. Previous studies have suggested that men often find it easier to lose weight than women (Jackson, Beeken, & Wardle, 2014; Stubbs et al., 2011), and it is possible that participants' experience of the intervention would differ by gender. However, as previously stated in Study 4, women are more willing to participate in weight loss interventions (Jebb et al., 2011), and have a higher prevalence of dieting than men (Hartmann-Boyce et al., 2015; Provencher et al., 2004). Additionally, participants were mostly white, well-educated and relatively wealthy. A systematic review of self-help programmes suggested that interventions carried out without the support of a professional may be more effective in socio-economically advantaged groups (Hartmann-Boyce et al., 2015).

A further limitation includes the use of 'Big Panel' members who register to a charity with a view to participating in weight management studies is a potential cause for selection bias. As mentioned in Study 4, Section 7.8.4, little is known about whether e-mail contact with participants still works or if their contact details are correct and many panel members have been invited to lots of studies before, which could increase or decrease their motivation to participate in the study. Even though participants appeared to be enthusiastic about the tips and liked the information in general, difficulties expressed by some participants may have been exacerbated by previous weight loss failures, and hence, discouraged some participants from following the tips. The findings of this study therefore cannot be generalized to other populations and future research should explore the efficacy and acceptability of personalized appetitive trait based weight management interventions in more diverse samples.

As per the COREQ 32 item checklist, the only item not covered in this study was number 23 (Transcripts returned) (Appendix 8.3), as the transcripts were not returned to participants for comments and/or corrections after the interviews, not giving the chance to participants to clarify any doubts that could have arisen from transcription. Also, the fact that I ran the eight-week intervention, communicating directly with participants and also personally conducted all 21 interviews myself could have resulted in researcher bias. For example, eliciting narrowly defined answers to questions during interviews (e.g. 'yes'), to questions such as "did you find the delivery of the tips via e-mail to be adequate?". However, this was partially mitigated by the involvement of other researchers, with agreement on inter-

rater coding and discussion of the underlying themes. Finally, these interviews took place shortly after the intervention so provide participants' views only immediately post-intervention.

8.7.5 Conclusions

Results from the present study appear to lend support to the utility of a brief, tailored weight loss intervention of appetitive traits. Overall, interviewees were positive about their experiences of the ATTI. Interviews were obtained from 16 participants who engaged with the intervention, although five interviews were carried out in participants who engaged only briefly with the intervention. Three themes emerged from the interviews which related to participants' experiences of the intervention, consequences of the intervention, and barriers and facilitators to adherence. In general, participants found that they could engage with the tips because they were simple, clear and their delivery accessible. They found the tailored aspect of the intervention to be novel and motivational, comparing favourably with other weight loss programs as it focused on drivers of behaviour. However, mostly non-engaged participants found the intervention to be too low intensity, and suggestions were made for the inclusion of more tips, particularly 'emotional over-eating' tips, as well as a variety of different tips to suit different behaviours. Participants suggested that some form of personal contact at the beginning of the intervention could facilitate engagement with the tips and accountability, and improve specific aspects of the tips to improve tailoring. Overall, the ATTI appeared to increase self-awareness, lead to changes in behaviour and have other positive physical consequences such as feeling more energetic and having impact on physical training. Finally, lack of routines and 'bad' habits, were seen as barriers to adherence to the tips. Engaged participants found support from social networks facilitated adherence but living with family members who consumed unhealthy foods in the house also presented barriers.

These results are promising for the initial testing of this novel intervention, which along with the results from Study 4, Chapter 7, covers the first five Steps of the 6SQuID. It suggests that tailoring an intervention to an individual's appetitive traits is acceptable and could help support weight loss attempts. However, it was difficult to obtain qualitative data from 'non-completers' so more needs to be done to identify reasons for non-completion given the high level of drop out in Study 4. Future studies should also seek to refine the intervention based on these results and to explore its effectiveness for weight loss.

Chapter 9. General Discussion

9.1 Introduction

Given the rising prevalence of obesity on a worldwide scale, there is a need for novel and effective weight management interventions. The significant inter-participant variability in many behavioural intervention responses has led to a growing interest in the idea of personalised interventions tailored to individuals' needs. A potential target for such interventions could be to use a person's unique appetitive trait profile to tailor weight management advice for overweight or obese individuals. However, first there is a need to further understand the relationships between appetitive traits and weight, and to observe if the associations seen in childhood still hold into adulthood. The Child Eating Behaviour Questionnaire is a robust measure of appetitive traits that have consistently shown an association with weight across infancy and childhood (Ashcroft et al., 2008; van Jaarsveld et al., 2011). However, studies exploring these appetitive traits across the life course have been limited by the lack of a comparable self-report measure of these traits for adults. Measurement of these appetitive traits in adulthood would contribute to our understanding of how appetite influences weight gain at older ages, as well as providing potential targets for interventions. Psychometric measures of appetitive traits have not previously been used to tailor weight management interventions. Therefore, the aim of the research presented in this thesis was to address gaps in the existing literature by investigating the relationship between appetitive traits and BMI in adulthood, and to explore the potential for a weight management intervention to be tailored to an individual's appetitive profile.

9.2 Summary of findings and contribution to the literature

The work presented in this thesis was based on four research questions, addressed in five empirical studies. Study 1 was a systematic review of the literature on psychometric measures of appetite and appetitive traits. Studies 2 and 3 collected data from an on-line research panel in order to develop a new measure of appetite, validate it, and study its relationship with weight. The fourth study developed and tested a brief intervention based on tips tailored to an individual's appetitive profile, and aimed to assess facilitators and

barriers to their use. The fifth and final study explored participants' experiences of using the tips through qualitative research. This chapter discusses the main findings of the thesis based on the research questions proposed and the contributions they make to the literature. It reflects on limitations, as well as directions for future research and implications for practice and policy.

9.2.1 What psychometric measures of appetitive traits currently exist?

Study 1 systematically reviewed existing psychometric measures of appetitive traits, to assess the need for a novel measure of appetite in adulthood. To the best of my knowledge, this is the first systematic review to explore psychometric measures of appetite. Results from this systematic review revealed 32 psychometric measures of appetite for children, adolescents and adults.

After scoring the reviewed questionnaires to determine their validity and reliability, and whether associations with weight were reported, 17 measures obtained the highest score for psychometric robustness. The CEBQ was the only one of these robust questionnaires to measure an array of aspects of appetite to use behavioural validation studies (Carnell & Wardle, 2007). Following a further citation search using Google Scholar, three out of the 17 measures emerged as the most widely used: the TFEQ (Stunkard & Messick, 1985), and the DEBQ (van Strein et al., 1986), mostly for use in adults, and the CEBQ for use in children. The most common traits measured in adult questionnaires that have been associated with weight, relate to aspects of 'restraint' and disinhibited eating. Many studies using these measurements were undertaken in populations with weight management issues and eating disorders. From studies using the CEBQ, most of the evidence points to relationships between 'satiety responsiveness' and 'food responsiveness' and weight. No equivalent measure of 'satiety responsiveness' was found in adults. Although 'food responsiveness' measured using the CEBQ is similar to 'external eating' measured by the DEBQ, the former is unrelated to dieting and 'restraint', and has not been measured in adults. Several measures assess 'emotional eating', however the CEBQ also measures 'emotional under-eating' which has also not previously been measured in adults. The CEBQ also measures 'enjoyment of food', 'slowness in eating', 'desire to drink' and 'food fussiness' not currently measured in adults. Study 1 demonstrated that no currently available questionnaire could measure similar appetitive traits across the life course, from infancy to adulthood. However there was potential; for this to be achieved using the BEBQ in infants, the CEBQ in children and a self-report version of the CEBQ adapted for adults.

9.2.2 Can the parent report 'Child Eating Behaviour Questionnaire' (CEBQ) be adapted into a valid and reliable measure of appetitive traits in adults?

Study 2, Chapter 5, described the development of the 'Adult Eating Behaviour Questionnaire' (AEBQ). The self-report AEBQ was adapted from the parent-report CEBQ with the addition of a 'hunger' scale, and the removal of the 'desire to drink' scale. Based on piloting, the response options were changed from: 'never', 'rarely', 'sometimes', 'often' and 'always', to 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree'. Exploratory factor analysis in a large sample of adults, revealed a final 35 item questionnaire measuring three 'food approach' traits ('hunger and food responsiveness' which loaded onto the same factor, 'emotional over-eating' and 'enjoyment of food') and four 'food avoidant' traits ('satiety responsiveness', 'emotional under-eating', 'food fussiness' and 'slowness in eating'). Cronbach alpha values were greater than 0.7 for the seven traits, providing evidence for the internal reliability of the AEBQ.

Study 3, Chapter 6, confirmed the factor structure of the AEBQ in a second sample of adults. Confirmatory factor analysis revealed the same structure as Study 2, except a better model fit was found when 'hunger' and 'satiety responsiveness' were separated into two factors, revealing eight final sub-scales. Reliability measurements showed that the AEBQ was internally reliable and results from a test-retest two weeks apart revealed the AEBQ to be reliable over time.

The findings from Studies 2 and 3 (described in Chapters 5 and 6 respectively) show that the AEBQ is a reliable and valid questionnaire that measures eight distinct appetitive traits in adults.

9.2.3 How do appetitive traits relate to BMI in adults?

After confirming the factor structure of the AEBQ, Study 3 also explored the relationship between appetitive traits captured by this questionnaire and BMI in adulthood. Results revealed similar associations between appetitive traits and BMI in adults to those previously reported in children. Positive associations were seen between BMI and the 'food approach' traits; 'food responsiveness', 'emotional over-eating' and 'enjoyment of food'. On the other hand, negative associations were seen between BMI and 'food avoidance' traits; 'satiety responsiveness', 'emotional under-eating' and 'slowness in eating'. Results were consistent with studies in infants (van Jaarsveld et al., 2011) and

children (Santos et al., 2011; Sleddens et al., 2008; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009), but associations were more modest in our sample of adults. This may be indicative of appetitive traits exerting a differential influence on weight across the life course. Furthermore, adults may actively restrict their energy intake in an attempt to control their weight, which could suppress the impact of certain traits on BMI, whereas children typically do not exert such control over their eating.

No associations were found between BMI and the newly added 'hunger' scale. In retrospect, this may be because the items to measure 'hunger' within the AEBQ, represent more of a 'state' rather than a 'trait' (Blundell et al., 2009; Harrold et al., 2012), and therefore may be more affected by temporal factors such as the time of the last meal (Blundell et al., 2009). 'Food fussiness' was also unrelated to BMI in this adult sample, whereas CEBQ measured 'food fussiness' has been linked with lower weight in some child studies (ref). It is possible that 'food fussiness' in adults is directed towards a much smaller number of foods, while greater variation exists in relation to children's 'food fussiness' (Crocker et al., 2011; Spence et al., 2011; Webber et al., 2009). Picky eating in adults is also associated with forms of unhealthy eating (Kauer, Pelchat, Rozin, & Zickgraf, 2015). However, relationships between 'food fussiness' and BMI in children have not always been consistent (Santos et al., 2011; Svensson et al., 2011). Future research using the AEBQ will determine if the 'hunger' and 'food fussiness' scales should be retained, and their importance in relation to weight as appetitive traits in adults.

9.2.4 Can a weight management intervention tailored to an individual's appetitive traits be developed that is acceptable and potentially useful?

Study 4, Chapter 7, involved the development and initial testing of an intervention tailored to an individual's appetitive profile, the 'Appetitive Trait Tailored Intervention' (ATTI). The first five steps of Wight et al.'s 6SQuID were followed (Wight et al., 2015), and the study fell within the 'development' phase of the Medical Research Council (MRC) framework for developing and evaluating complex interventions (Craig et al., 2008).

Tips were developed for 'food responsiveness', 'satiety responsiveness', 'emotional over-eating' and 'slowness in eating' traits, as these provided the widest scope for change. No tips were developed for 'hunger' or 'food fussiness' as no relationships were observed between these traits and BMI in Study 3. Tips were also not developed targeting 'enjoyment of food' as the majority of participants scored highly on this trait and it is problematic to tell someone not to enjoy food. Similarly no tips were developed for

'emotional under-eating' which does not appear to lead to weight gain (Wardle, Guthrie, et al., 2001). The tips were developed to help bring about change based on CBT techniques such as 'stimulus control' and 'response substitution', using recommendations taken from 'Shape-Up', a behavioural healthy lifestyle program for weight loss (Wardle et al., 2013). Other behaviour change techniques such as goal setting were incorporated into the tips to support change (Michie, Atkins, et al., 2014).

In order to establish if participants would like to receive such an intervention and how they would prefer it to be delivered, feasibility questions were included in Study 3. Participants were asked if they would be interested in participating in an on-line intervention involving tailored feedback on their appetitive traits based on their AEBQ results. More than half of the participants (58.4%) replied that they would be interested in receiving this feedback and tips on how to manage them accordingly. The majority of participants also reported that they would prefer to receive this information via e-mail (63.4%), rather than in-person (2.1%), and would also like to be reminded on a weekly basis to continue following the recommendations (63.4%).

Both the theoretical background and the feasibility study results informed the development and testing of the intervention on a small scale, within Study 4. Participants completed the AEBQ and received a set of personalised tips based on their adverse appetitive trait profile along with weekly reminder e-mails. Out of 53 participants at baseline, a total of 32 participants completed the study and provided a final weight. A mean weight loss of 1.2 kg was reported over the eight-week intervention. Participants reported that they liked and used the majority of the tips except for the 'emotional over-eating' tip and two of the tips for managing 'food responsiveness'. They also reported a number of barriers similar to those described in previous weight management interventions, such as: 'force of habit', or 'forgetting to carry them out', as well as external situations making it difficult to follow specific tips.

In order to gain further insight into the acceptability of the ATTI, semi-structured qualitative interviews were conducted with 21 intervention participants, five of whom had not engaged with the study. These findings are reported in Study 5, Chapter 8. Thematic analysis of semi-structured qualitative interviews revealed three themes with their own sub-themes. First, the experience of the intervention theme with five sub-themes: Engaging with the tips and materials; the importance of tailoring; focus on drivers of behaviour change; too low intensity: a desire for more information; and, the role of

personal contact. The second theme, consequences of the intervention with three sub-themes: Increased self-awareness; behaviour change; and physical consequences. The third and last theme, barriers and facilitators to adherence with two sub-themes: Routines and habits; and, social networks. Overall, the results indicated that participants found that they could engage with the tips because they were simple, clear and their delivery was accessible. Tailoring of the tips based on appetitive traits was seen as novel and motivational. The non-engaged participants found the intervention to be too low intensity, and in particular the 'emotional over-eating' tips were seen as not including enough information. Suggestions were made to include a greater variety of different tips for each trait. Participants also suggested including some form of personal contact particularly at the beginning of the intervention, preferably with a health professional. Some of the consequences of following the ATTI, were that participants reported changes in their behaviour and physical consequences of following the tips (such as finding other things to do instead of eating, no longer eating all the food on their plate, feeling more energetic, and improved physical training), and this was due partly to an increase in self-awareness. The main barriers to adherence with the tips were a lack of routine and 'bad' habits. Social support was both a facilitator and barrier to adherence, where for example families could be a help (by providing encouragement) or a hindrance (such as having family members in the house who were 'not on a diet').

Together, Studies 4 and 5 provide evidence supporting the use of AEBQ measured appetitive traits to inform a personalised weight management intervention targeting the aspects of an individual's appetitive profile that put them at greatest risk of weight gain. However, some aspects of the intervention were less effective and/or engaging and there is a need to refine the intervention based on the results obtained from both of these studies. Given the high level of drop out in Study 4, more work is also required to identify reasons for non-completion. Future work should seek to refine the tips, further explore reasons for drop out, and ultimately test the effectiveness of the ATTI within a powered study.

9.3 Limitations

Limitations corresponding to each study are outlined in the relevant chapters. However, some limitations are common to several of the studies and are further discussed below.

9.3.1 Self-reported data

Self-reported measures may result in socially desirable responses. Social desirability is a well-documented issue in questionnaire studies (Allison & Baskin, 2009; Carnell & Wardle, 2008a). These issues might have been particularly relevant to Studies 2, 3, 4 and 5, given the nature of the information collected, regarding appetite and sensitive issues such as weight and weight management (Cameron & Evers, 1990). Given the societal preference for thinness and the prevalence of weight stigma, individuals who are heavier might be particularly influenced by social desirability bias (Polivy & Herman, 2004; Wee et al., 2013). These issues could have resulted in under-estimated levels of certain appetitive traits such as 'food responsiveness' or 'emotional over-eating' or over-estimates of 'satiety responsiveness'. However suggestions have also been made that web-based data collection can reduce social desirability pressures (Marlow & Wardle, 2014), by reducing contact with health professionals.

Other issues common to self-report questionnaires are the under-reporting of weight and over-reporting of height measurements, which in turn leads to BMI under-estimates (under-reporting bias) (Gorber et al., 2007). This introduces systematic error into self-reported measures (Rowland, 1990). This could have been an issue for each study included in the systematic review in Study 1, where convenience samples and mostly self-reported weights and heights are obtained from participants. This is also an issue in Studies 2, 3, and 4 where all participants self-reported their weights and height. Therefore, it is very likely that under-estimation of BMI was a common issue throughout this thesis. Self-reported measures of height and weight are also known to be less accurate in older age groups (Kuczmarski et al., 2001). Therefore, self-reported height and weight measurements in those participants above 60 years of age in Studies 2, 3, and 4, might be further under-estimated, with nearly a quarter of participants who completed the appetitive trait intervention (Study 4) over the age of 60. Possible implications of such under-reporting could lead to lack of associations between appetitive traits and weight in older age groups, compared to younger age groups.

9.3.2 Cross-sectional data

The nature of cross-sectional data in general, does not allow for inferences on causation. For example, in the case of Study 3, associations were seen between appetitive traits and BMI in the sample. Results from studies in children have suggested that appetitive traits are associated with BMI (Carnell & Wardle, 2008b; Sleddens et al., 2008; Viana et al., 2008),

and in infancy appetitive traits have been identified as an early marker for future weight gain (van Jaarsveld, Boniface, Llewellyn, & Wardle, 2014). My results show that appetitive traits are associated with BMI in adults, however no causal inference can be made from the results in Study 3.

Prospective longitudinal research is required to study the nature of directionality of the above mentioned associations. Results from Study 3 however, provided the basis for these questions to be addressed in future studies.

9.3.3 Loss to follow-up

Study 4 was limited by the very low response rate when the 'Big Panel' members were first contacted, although response rates from this panel may be reduced by faulty e-mails or excessive contact from different study interventions. Once eligible participants were identified and 53 participants consented to take part in the ATTI, the study suffered in particular from high drop-out rates and loss to follow-up, even though many attempts were made to contact and retain participants through weekly reminders and personal e-mails. High drop-out rates could have been a consequence of the lack of personal, face-to-face contact, inherent with internet-based delivery (Arem & Irwin, 2011). Other possible reasons for the loss to follow-up may have been associated with participants not relating to the profiling from their AEBQ answers, and personal contact could have allowed for such issues to be discussed. Also a 'bank' of tips for each trait to cover differences in participants' behaviours, including sending participants' different tips to follow per week, and further reminders to continue using them, might have improved participants' involvement.

In Study 5, difficulties arose trying to obtain interviews from participants who did not finish the study or who failed to provide their final weight. Five participants who were considered not to have engaged with the ATTI were interviewed, out of a total of 21 interview participants. Results from more participants who did not follow the tips, weren't engaged or did not finish the study is likely to have enriched the findings. It is possible that loss to follow-up could have been reduced by providing participants with incentives to participate in Study 4 and then further incentives for participating in Study 5 (Treweek et al., 2013).

9.4 Implications for future research, practice and policy

The findings of this thesis contribute to our understanding of appetite and weight in adults and have implications for researchers, health practitioners and policymakers. The results and limitations of this research opens up several areas for future inquiry in the field of appetitive traits in adults.

First, there is a need to determine if the AEBQ is a valid measure of appetitive traits in adult populations in different countries and in different socio-economic and ethnic groups (Cao et al., 2012; Mallan et al., 2013; Sparks & Radnitz, 2012). Given their particular characteristics, different relationships between appetitive traits and weight might be seen in older adults and this requires further investigation (Jackson et al., 2014). Also, given the self-report nature of the AEBQ, it could potentially be administered to adolescents who are known to be one of the most vulnerable age groups in relation to weight issues (Lancet, 2012; Moreno et al., 2008). Evidence suggests that parents and adolescents may be discordant in reporting dietary intake (Northstone, Smith, Cribb, & Emmett, 2013), with less extreme responses given by self-reporting adolescents than those obtained via parent-report questionnaires (Waters, Stewart-Brown, & Fitzpatrick, 2003). There is particular interest from professionals who would like to obtain information about the relationship between appetitive traits and weight in adolescents (Carnell et al., 2013). Validating the AEBQ for use in adolescent samples could also enable tailored weight management interventions focused on modifying appetitive traits directed at this particularly vulnerable age-group (Neumark-Sztainer, Story, Perry, & Casey, 1999).

The findings of this thesis suggest the appetitive traits that have been most strongly associated with obesity in children remain important into adulthood. While the evidence is strongest for associations between BMI and both 'food responsiveness' and 'satiety responsiveness' in childhood (Llewellyn & Wardle, 2015; Syrad et al., 2016), the strongest relationships were seen between BMI and both 'emotional over-eating' and 'emotional under-eating' in adults. Furthermore, overall, the associations between BMI and appetitive traits in adults were found to be of lower magnitude than in children (Carnell & Wardle, 2008a). The high prevalence of weight loss attempts in overweight and obese adults (Nicklas et al., 2012; Provencher et al., 2004; Wardle & Johnson, 2002), suggests that these behaviours may play a role in the relationship between appetitive traits and BMI. Adults may be managing their weight and eating behaviours (Larson et al., 2009; Nicklas et al., 2012). Future research could involve asking participants if they are currently managing

their weight, and also to look at their ability to self-regulate their eating behaviour, given that those trying to lose weight may not be doing so successfully (Johnson et al., 2012; Johnson & Wardle, 2014). Studying the moderating effects of current weight loss attempts and self-regulation of eating behaviour on the relationship between appetitive traits and BMI could shed further light on adults' appetitive behaviours and support appropriate weight loss methods among overweight and obese adults.

Tracking of appetitive traits has been explored across childhood, where 'food responsiveness', 'emotional over-eating' and 'enjoyment of food' were found to increase from age four to age 10, in twins from the Twins Early Development Study (TEDS). 'Satiety responsiveness', 'slowness in eating', 'emotional under-eating' and 'food fussiness' were found to decrease with age (Ashcroft et al., 2008). Currently the TEDS cohort are between 20 and 22 years old (born between 1994 and 1996), and continue to participate in research (Haworth, Davis, & Plomin, 2013). Administering the AEBQ to the TEDS twins could provide evidence of the longitudinal continuity and stability of these traits from childhood into adulthood.

Research is still needed to determine the heritability of these traits in adults. Appetitive traits have been found to have a heritable component both in children (Carnell et al., 2008), and infants (Llewellyn et al., 2012). As data becomes available from adult twin populations, the twin method could be used to quantify genetic and environmental contributions to AEBQ measured appetitive traits in adulthood (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2010; Llewellyn & Wardle, 2015).

Experimental research using laboratory measures of appetite could be used to further validate the AEBQ, as was carried out for the CEBQ (Carnell & Wardle, 2007). Laboratory measured 'eating in the absence of hunger' (EAH), would help validate 'food responsiveness' and 'enjoyment of food' (Birch et al., 2003; Fisher & Birch, 1999). Caloric compensation studies could assess the validity of 'satiety responsiveness' and 'slowness in eating' under laboratory conditions (Johnson & Birch, 1994; Mattes, Pierce, & Friedman, 1988). Furthermore, neuroimaging studies could also be used to track neurological appetite pathways triggered by food cues to link the 'homeostatic' and 'hedonic' neurological appetitive pathways with obesity and assess them against psychometric measures using the AEBQ (Carnell et al., 2013, 2012). Also validation of the AEBQ against other measures of appetite such as the DEBQ could be conducted to explore differences between food responsiveness and 'external eating'. Validation against measures such as

the 'Intuitive Eating Scale' (IES and IES-2), might help distinguish differences between measured 'satiety responsiveness' using the AEBQ and the intuitive aspect of satiation measured by the IES or IES-2 (Tylka & Kroon Van Diest, 2013; Tylka, 2006). More recently, the 'Power of Food Scale' (PFS) has been used to assess the psychological impact of today's food environment via three sub-scales ('food available', 'food present' and 'food tasted'), and additional validation could explore the relationship between the PFS and the AEBQ scales such as 'food responsiveness', 'enjoyment of food' and 'satiety responsiveness', to assess potential convergent validity between the scales.

Future research should also include obtaining objective measures of weight and height, which could help reduce BMI under-reporting issues, and result in more accurate estimates of associations between appetitive traits and BMI (Gorber et al., 2007). It would also be of interest to obtain additional objective anthropometric measures, including waist circumference which has previously been found to associate with appetitive traits in children (Carnell & Wardle, 2008a). Measurement of appetitive traits could also be correlated to dietary patterns (Emmett et al., 2015) and food preferences (Fildes et al., 2015), to assess how different food choices relate to different appetitive traits.

This thesis has identified associations between individual appetitive traits and BMI in adults, but more work is needed to confirm these findings and provide further insight into the relationships between appetite and weight across adulthood. Ultimately this could help to identify more effective ways to support individuals' weight loss attempts, and influence health practitioners' delivery of weight management advice. Given the rise in obesity prevalence, there has been an upsurge of weight loss methods provided by a fast growing industry ("Marketdata Enterprises, Inc.," 2014). Tailoring advice to individual traits capitalises on people's desire to receive personalised advice and could enhance the effects of other health-promoting messages (Kreuter et al., 1999). There is also a need for brief interventions which provide simple advice (Clark et al., 2004; Mata et al., 2010), and there is increasing interest in internet-based delivery of weight management advice as an affordable option that enables greater coverage than in-person advice (Arem & Irwin, 2011; Hartmann-Boyce et al., 2015).

The ATTI developed and tested in Studies 4 and 5 could be an acceptable and helpful approach to weight management that addresses some of these issues. It was relatively simple and involved instructing participants to follow the tips provided for a period of eight weeks. Tips were tailored according to participants' individual AEBQ scores. The

information in the tips appeared to help individuals to be able to better direct their attention to their own 'risky' traits and to learn specific ways to help curb them. Development of an app, and a website with appetitive trait information, as well as an on-line forum, could improve the support needed by participants to improve their adherence to the tips (Leske, Strodl, & Hou, 2012; Stubbs et al., 2011).

However, further work is required in order to make definitive recommendations about the use of appetitive traits in weight management, including refinement of ATTI delivery and of the tips themselves. Intervention participants may benefit from initial and final contact with a health professional. Personal contact with a health professional is known to increase weight loss success (Jebb et al., 2011; Metzgar et al., 2014). Personal contact would also allow objectively measured height and weight to be taken, as well as a more personalised AEBQ profiling with sufficient explanation of adverse appetitive traits and their corresponding tips. However this might impact on the simplicity of the delivery, increasing the resources required for implementation (Clark et al., 2004; Lally, Chipperfield, & Wardle, 2008; Mata et al., 2010), and would change the intervention's status as a self-help weight loss treatment (Hartmann-Boyce et al., 2015).

It may also be worth exploring whether the ATTI could be used alongside other weight loss programmes to boost effectiveness and the feasibility of its use within different health care settings. For example, there is the potential to use the ATTI in the primary care setting. This would address individuals' desire for input from a healthcare professional, and would be a relatively simple, brief way of providing tailored weight management information to better meet individual needs. In this context, it could either be stand alone, or it could be incorporated into existing weight management or health promotion programmes.

Refining of some of the tips, increasing the number of tips, and varying suggestions of behaviours to fit the needs of different participants could also improve future adherence to the ATTI. For example the single 'emotional over-eating' tip could be improved by including more tips which introduce the concept of changing emotions and negative thoughts around food (Wardle et al., 2013). Instead of suggesting to participants with high 'food responsiveness' to follow the "suggest doing things with friends that don't involve food, like going for a walk in the park" tip, maybe providing a different option such as: "if going out with friends involves eating, try to make healthy food choices, and don't get carried away by what your friends are eating", could improve adherence. These refinements could allow the rigorous implementation of the ATTI as the sixth step for Quality Intervention

Development (6SQuID) defined by Wight et al., (2015), and intervention implementation in relation to the MRC steps of complex intervention development (Craig et al., 2008). Results from Studies 4 and 5 also indicate the need to explore why people dropped out of the study. Further qualitative work with the target population may help to un-pick some of the issues. Future studies and implementation of the ATTI could also further explore avenues for reducing drop-out rates, through attempts at personal contact, different reminder systems, and the use of incentives.

Lastly, this research has implications for policymakers because a better understanding of the causes of obesity with respect to appetitive traits, highlights how structural changes may be effective. For example, when considering the importance of ‘food responsiveness’ on adiposity risk, the way that foods are displayed at supermarkets could be manipulated to discourage unplanned purchases of unhealthy foods. Implementing ‘nudging’²⁷ techniques to encourage healthy food choices both in laboratory experiments and in naturalistic settings, such as supermarkets, has shown positive results (van Kleef, Otten, & van Trijp, 2012). Increased availability, visibility and wider assortments of healthy snacks has been shown to facilitate healthy snack choice (Petrescu et al., 2016; van Kleef et al., 2012). Reducing portion sizes was one of the ‘satiety responsiveness’ tips used in the ATTI. Reducing the portion sizes of pre-prepared foods and beverages has been suggested at a policy level and is supported by the Childhood Obesity Strategy for England, to reduce sugar consumption (Reed, 2016). Overall, different strategies could be used to provide advice for the presence of some of these traits on a broader population level.

9.5 Concluding remarks

This thesis aimed to address existing gaps in the literature relating to the relationship between appetitive traits, weight, and weight management in adulthood. Overall, the findings make an important contribution to this literature. The AEBQ is a novel measure of

²⁷ Nudging techniques help to modify the environment, to help people make changes to their behaviours without the conscious awareness of the participants (Petrescu et al., 2016; van Kleef et al., 2012).

appetitive traits that will enable tracking of these traits, and their associations with BMI, from infancy, into childhood, and now into adulthood. The findings from this thesis suggest that traits associated with BMI in childhood are also associated with BMI in adulthood, although associations are smaller. These associations suggest appetitive traits could be a potential target for weight management interventions. The development and preliminary testing of the ATTI found individuals' AEBQ measured appetitive profiles can be used to inform a tailored intervention to help people with overweight or obesity better manage their weight. These findings highlight the potential importance of appetitive traits for weight and weight management in adults, and pave the way for future research to explore these relationships further.

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Appendices

Appendix 4.1 Complete electronic search strategy for the systematic review in Chapter 4

1. (eating adj2 behavio\$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

2. appetit\$.mp.

3. 1 or 2

4. exp Questionnaires/

5. scale\$.mp.

6. measure\$.mp.

7. instrument\$.mp.

8. 4 or 5 or 6 or 7

9. exp Food/

10. eat\$.mp.

11. 9 or 10

12. validat\$.mp.

13. (factor\$ adj2 struct\$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]

14. reliability.mp.

15. development.mp.

16. adaptation.mp.

17. 12 or 13 or 14 or 15 or 16

18. 3 and 8 and 11 and 17

19. limit 18 to humans

Appendix 4.2 Standards for educational and psychological testing – does not include all of the standards relevant to the development of high stake instrument, fairness in testing and issues of cultural sensitivity (Chapter 4)

Standards

Test development

1. The purpose of the test must be clearly stated, with a definition of the construct being measured.
2. Specifications about normative or standardization sample must be given.
3. The items and response formats should be reviewed by a panel of experts, whose qualifications should be specified.
4. Any pilot testing should be described, including characteristics of the sample(s) tested.
5. The criteria for keeping and rejecting items, whether based on judgement, classical test theory, or item response theory, must be given.
6. If the items are selected on the basis of empirical relationships (e.g. factor analysis, item-total correlations) rather than on theoretical grounds, then there should be at least one cross-validated study to confirm the results. Any discrepancies between the results of the studies should be documented.
7. Some evidence should be given regarding the content coverage of the scale.
8. If the items are weighted, a rationale (either statistical or theoretical) should be given for the weights.
9. If scoring involves more than simply adding up the responses, then detailed instructions should be given, including any training that is required of the raters or scorers.
10. If a scale is used only for research purposes, this should be clearly stated to the test taker.
11. If a short form of the test is developed, then two things must be specified: the procedures or criteria by which items were selected for deletion, and how the short form's psychometric properties compare against the original (e.g. reliability, validity).
12. If, due to research or theory, the definition of the domain has changed significantly from the time the instrument was originally developed, then the scale should be modified to reflect this.

Reliability

1. The reliability and standard error measurement (SEM) must be reported for the total score. If the instrument has sub-scales, then this information must also be given.
 2. When differences scores are interpreted, the reliabilities and SEMs of the differences scores should be reported.
 3. The sample must be described in sufficient detail to allow the readers to determine if the data apply to their groups.
 4. The procedures that were used must be explained (e.g. test-retest interval, any training given to the raters, etc.).
 5. If the reliability coefficients were adjusted for restriction in range, then both adjusted and unadjusted values should be reported.
 6. If there is reason to believe that the reliability may vary with age, or with different groups, the reliabilities and SEMs should be reported separately for these groups, as soon as sufficient data are available.
-

Validity

1. Because no test is valid in all people and in all situations, the population for which the test is appropriate should be clearly stated, including relevant sociodemographic information.
 2. If the scale is to be used in a novel way, validity data must be gathered to support this new use.
 3. A rationale should be given for the domains covered or not covered in the content validation phase of development.
 4. When any phase of development depends on the opinions of experts, raters or judges, the qualifications of these people should be given, as well as any training or instructions they may have received.
 5. Sufficient details should be reported about any validation studies to allow users to judge the relevance or the findings to their local conditions.
 6. When the validation studies involve relating the new scale to other measures, the rationale and psychometric properties of the measures must be given.
 7. If adjustments have been made for restriction in the range of scores, both adjusted and unadjusted coefficients should be reported.
-

Source: (American Educational Research Association et al., 1999; Streiner & Norman, 2015)

Appendix 4.3 Validity and reliability measures of questionnaires from the systematic review in Chapter 4 – Extended version

#	Reference	Internal reliability	Test-retest reliability	Convergent/content/criterion validity	Discriminant validity	Psychometric evaluation
Emotional Eating Scale (EES)						
1	(Arnouk et al., 1995)	$\alpha=0.81$ (0.72 to 0.78)	2-week test retest ($r = 0.79$, $p<0.001$).	Higher levels of all EES sub-scales correlated with greater severity of binge eating (BES) ($p<0.001$). Significant associations between EES and Anger/Frustration and Depression sub-scales and TFEQ-D scale ($p<0.05$).	No measures of psychological adjustment (BDI, SCL-90-R, RSE) were significantly related to the EES sub-scales. No associations between the EES sub-scales and TFEQ-CR.	4
Emotional Eating Scale - Adapted for use in Children and Adolescents (EES-C)						
2	(Tanofsky-Kraff et al., 2007)	α (0.83 to 0.95)	3.4 \pm 2.6 months ICC (0.59 to 0.74)	Higher levels of all EES-C sub-scales in children with recent LOC eating episodes than No LOC (p 's < 0.05).	The EES-C Anger/Frustration and EES-C Unsettled were unrelated to measures of trait and state anxiety, externalised behaviours. LOC participants had higher EES-C-Depression than No LOC participants which reveals sub-scales may discriminate against measures of general psychopathology.	4
Eating Identity Type Inventory (EITI)						
3	(Blake et al., 2013)	α (0.61 to 0.82)	$r=0.78$ to 0.84 for healthy, emotional, and picky eating identity types $r=0.66$ for meat eating types	Convergent validity with dietary intake measures ($p<0.05$ to $p<0.001$)	-	3
Palatable Eating Motives Scale (PEMS)						
4	(Burgess et al., 2014)	α (0.73 to 0.91)	(Boggiano et al., 2015) $r=0.98$, $p<0.001$	Significant associations between the PEMS sub-scales and YFAS food dependence and BES scores ($p<0.01$ for all sub-scales).	A small but significant association between the PEMS Coping subscale and BIS scores ($p<0.01$). Other sub-scales were not significantly associated with BIS.	4
Palatable Eating Motives Scale for kids (K-PEMS)						
5	(Boggiano, Wenger, Mrug,	α (0.64 to 0.90)	-	-	-	1

Burgess, & Morgan, 2015)						
Power of Food Scale (PFS)						
6	(Cappelleri, Bushmakin, Gerber, Leidy, Sexton, Karlsson, et al., 2009)	S1: α (0.81 to 0.88) S2: α (0.82 to 0.91)	(Lowe et al., 2009) S3: ($r = 0.77$, $p < 0.001$)	TFEQ-R21: UE: 0.64 (0.54–0.70) EE: 0.51 (0.40-0.63) suggesting the PFS and TFEQ-R21 UE and EE sub-scales were measuring similar but distinct aspects of eating.	TFEQ-R21: CR: -0.16 (-0.27 to -0.05), suggesting the PFS and TFEQ-R21 CR were measuring different aspects of eating.	4
State and Trait Food-Cravings Questionnaires (FCQ-S and FCQ-T)						
7	(Cepeda-Benito et al., 2000)	S1: FCQ-T: α (0.81 to 0.94) S2: FCQ-S: α (0.82 to 0.88)	3-weeks S1: FCQ-T: r (0.72 to 0.88) S2: FCQ-S: r (0.40 to 0.63) not stable over time	FCQ-T correlated to TFEQ-D and TFEQ-H: r (0.31 to 0.66)	FCQ-T was largely uncorrelated to TFEQ-CR: r (0.04 to 0.46). FCQ-S was largely uncorrelated to TFEQ sub-scales: r (0.04 to 0.41), where only Lack of Control and Desire correlated.	4
Brief version of the Food-Cravings Questionnaire-Trait (FCQ-T) (FCQ-T-r)						
8	(Meule et al., 2014)	$\alpha = 0.94$	-	FCQ-T-r against the RS (0.32 to 0.78) with 2/ items ($p < 0.01$)	-	2
General index of food craving (G-FCQ-T and G-FCQ-S)						
9	(Nijs et al., 2007)	S1: G-FCQ-T $\alpha = 0.90$ G-FCQ-S $\alpha = 0.92$ S2: G-FCQ-T $\alpha = 0.90$ G-FCQ-S $\alpha = 0.92$	S2: 3-weeks ICC 0.79	S2: G-FCQ-T positively correlated DEBQ-EE $r = 0.71$, $p < 0.01$; DEBQ-ExtE $r = 0.51$, $p < 0.01$ G-FCQ-S positively correlated with DEBQ-EE $r = 0.19$, $p < 0.01$; and DEBQ-ExtE $r = 0.30$, $p < 0.01$.	S2: No correlations between G-FCQ-T and DEBQ-RS $r = 0.04$	4
Control of Eating Questionnaire (CoEQ)						
10	(Dalton et al., 2014)	α (0.88 to 0.66)	-	Craving Control was negatively related with TFEQ-D ($p < 0.001$) and TFEQ-H ($p < 0.001$) and binge eating tendency ($p < 0.001$) TFEQ-D and binge eating tendency were	-	2

negatively related to Positive Mood
($p < 0.001$).

Emotional Appetite Questionnaire (EMAQ)						
11	(Geliebter & Aversa, 2003)	$\alpha = 0.78$ and 0.75 for EMAQ-NE and EMAQ-PE $\alpha = 0.65$ and 0.57 for EMAQ-NS and EMAQ-PS	$r (0.71 \text{ to } 0.95)$	(Nolan et al., 2010) Significant positive correlation between the Negative Emotions and Situations scores of the EMAQ and the DEBQ-EE ($P < 0.0001$).	(Nolan et al., 2010) Low correlations of EMAQ positive emotions and situations scores with the DEBQ-EE score.	4
Motivation for Eating Scale (MFES)						
12	(Hawks, Merrill, & Madanat, 2004)	$\alpha (0.75 \text{ to } 0.95)$	4 weeks $r = (0.55 \text{ to } 0.77)$	MFES Emotional eating subscale was highly correlated with each of the three EES sub-scales ($p < 0.001$) and with TFEQ-D ($p < 0.001$) and TFEQ-H ($p < 0.001$). Environmental and Social eating sub-scales showed similar but weaker correlation with EES ($p < 0.001$ to $p = 0.068$) the TFEQ-D ($p < 0.001$ to $p = 0.079$) and TFEQ-H ($p < 0.001$ to $p = 0.004$). Physical eating was significantly correlated only with the TFEQ-D ($p < 0.05$).	-	3
Intuitive Eating Scale (IES-H)						
13	(Hawks et al., 2004)	$\alpha (0.42 \text{ to } 0.93)$	4-weeks $r = 0.56 \text{ and } 0.87$.	CBDS and total scores for each of the four factors were $r = -0.84$ ($p < 0.0001$) for intrinsic eating, $r = -0.42$ ($p < 0.0001$) for extrinsic eating, $r = -0.484$ ($p < 0.001$) for anti-dieting,	CBDS and scores for IES self-care sub-scale $r = -0.023$ ($p = 0.659$)	4
Mindful Eating Scale (MES)						
14	(Hulbert-Williams et al., 2014)	$\alpha (0.75)$ 5/6 subscales	-	Significant positive inter-correlations with several mindfulness and body acceptance questionnaires (not detailed here)	-	2

Chinese Pre-schoolers' Eating Behaviour Questionnaire (CPEBQ)						
15	(Jiang et al., 2014)	$\alpha=0.92$ (0.74 to 0.87)	2- weeks 0.72	Construct validity: Dimensions of positive eating (food responsiveness, exogenous eating, emotional eating, and initiative eating) tended to be positively correlated to each other and negatively correlated to dimensions of negative eating (food fussiness, eating habit, satiety responsiveness) ($p<0.05$ to $p<0.01$).	-	3
Food Situations Questionnaire (FSQ)						
16	(Loewen & Pliner, 2000)	$\alpha=0.80$ (0.71 and 0.73)	29.9 day mean $r=0.64$ (0.64 and 0.56)	Self-reported FSQ predicted willingness to try new foods under laboratory conditions, and better than parent report of their child's neophobia.	-	3
ecSatter Inventory (ecSI)						
17	(Lohse et al., 2007)	α (0.65 to 0.84)	(Stotts & Lohse, 2007) 2- to 6-week; $r=0.68$ (0.52 to 0.70)	Eating-competent persons (i.e. ecSI score ≥ 32) exhibited lower feelings of TFEQ-CR, TFEQ-D, and TFEQ-H ($p\leq 0.001$).	-	3
Meaning of Food Questionnaire (MOF)						
18	(Ogden et al., 2012)	α (0.6 to 0.9)	-	-	-	1
Food Neophobia Scale (FNS)						
19	(Pliner & Hobden, 1992)	α (0.88)	2 to 4 weeks: $r(38)=0.91$ and $r(31)=0.87$, $p<0.01$. 15-weeks: $r(59)=0.82$, $p<0.01$	Correlations between FNS and the GNS for the two samples were $r(128) = 0.54$, $p<0.01$ and $r(71)=0.62$, $p<0.01$.	FNS scores non-significant when correlated against measures of composite anxiety $r(28)=0.26$, as well as non-significant for low or high fear anxiety conditions (fear manipulations): $r(24)= 0.18$ and $r(25)=0.26$.	4
Food Neophobia Scale for children (FNS-C)						
20	(Pliner, 1994)	-	-	High correlations between behavioural measures of food neophobia (state) and paper and pencil measures of FNS-C (trait)	-	2

Italian Food Neophobia Scale for children (ICFNS)						
21	(Laureati et al., 2015)	$\alpha=0.71$	t-test comparisons ($p<0.05$)	ICFNS scores were significantly and negatively correlated with willingness to taste and liking of unfamiliar food.	-	3
Overeating Tension Scales (OTS)						
22	(Popkess-Vawter et al., 2000)	S1: α (0.74 to 0.88) S2: α (0.69 to 0.87) S3: α (0.74 to 0.93) S4: α (0.70 to 0.92)	-	S4: Significant correlation between OTS and BULIT ($r=0.37$, $p<0.01$)	-	2
Eating in Emotional Situations Questionnaire (EESQ)						
23	(Rollins et al., 2014)	$\alpha=0.86$ (0.70 and 0.81)	-	Only criterion validity of the EESQ subscales with the food frequency and eating behaviour measures, stratified by gender ($p<0.05$, $p<0.01$, $p<0.001$).	-	2
Eating Pattern Inventory for Children (EPI-C)						
24	(Schacht et al., 2006)	α (0.72 to .93)	-	-	-	1
Three Factor Eating Questionnaire (TFEQ)						
25	(Stunkard & Messick, 1985)	S3: Dieters: α (0.79 to 0.84) Free eaters: α (0.84 to 0.92) Combined sample: α (0.85 to 0.93)	(Ganley, 1988) One month: α (0.80 to 0.93)	(Gormally et al., 1982) Binge severity, quantified by a scale devised for that purpose correlated with TFEQ-D ($r=0.61$, $p<0.001$) but not with TFEQ-CR ($r= -0.14$, NS). Binge severity correlated with TFEQ-H ($r=0.54$, $p < 0.001$).	Discriminant measures were shown between subgroups of dieters and free eaters in S3 ($p<0.001$). (Gormally et al., 1982) Binge severity, did not correlated with TFEQ-CR ($r= -0.14$, NS)	4
Three Factor Eating Questionnaire revised version TFEQ-R18						
26	(Karlsson et al., 2000)	S1: α (0.76 to 0.85) S2: α (0.77 to 0.85)	-	12/21 items passed convergent validity.	Item discriminant validity revealed separating TFEQ-D and TFEQ-H was a problem	3
Three Factor Eating Questionnaire revised version TFEQ-R21_TFEQ-R18-V2						
27	(Cappelleri, Bushmakin,	S1: α (0.70 to 0.92)	-	-	-	1

	Gerber, Leidy, Sexton, Lowe, et al., 2009)	S2: α (0.78 to 0.94)				
Eating in the Absence of Hunger (EAH-C)						
28	(Tanofsky-Kraff et al., 2008)	α (0.80 to 0.88)	α : 0.65 to 0.70, p's <0.01	Good convergent validity with emotional eating and loss of control episodes ($p < 0.01$) (against measures of depression and anxiety).	The EAH-C Boredom/Fatigue scale discriminated from depressive symptoms ($r = 0.13$, $p = 0.20$), and the EAH-C External scale was not associated with State anxiety ($r = 0.05$, $p = 0.67$) and depressive symptoms ($r = 0.12$, $p = 0.25$).	4
Intuitive Eating Scale (IES)						
29	(Tylka, 2006)	S1: $\alpha = 0.89$ (0.72 to 0.89) S2: $\alpha = 0.85$ (0.85 to 0.87)	S4: 3-week $r = 0.90$ (0.74 to 0.88)	(Avalos & Tylka, 2006) IES total scores were moderately to strongly related to self-esteem and satisfaction with life and moderately related to optimism and proactive coping ($p < 0.001$). Unconditional Permission to Eat subscale was strongly related in a negative direction to eating disorder symptomatology (EAT-26) ($p < 0.001$). The Eating for Physical Rather Than Emotional Reasons subscale was moderately to strongly related to and satisfaction with life ($p < 0.001$).	IES total scores negligibly related to optimism and unrelated to proactive coping. Impression management was not related to the total IES, the Unconditional Permission to Eat subscale, or the Eating for Physical Rather Than Emotional Reasons subscale.	4
Intuitive Eating Scale 2 (IES-2)						
30	(Tylka & Kroon Van Diest, 2013)	S1: F: $\alpha = 0.89$ (0.81 to 0.93); M: $\alpha = 0.87$ (0.82 to 0.92) S2: F: $\alpha = 0.88$ (0.81 to 0.93); M: $\alpha = 0.89$ (0.83 to 0.92) S3: F: $\alpha = 0.85$ (0.77 to 0.92); M: $\alpha = 0.88$ (0.82 to 0.92)	3 weeks $r = 0.88$ among women and $r = 0.92$ among men for the IES-2 total score.	Correlations were $r = 0.87$ for women and $r = 0.91$ for men between the original IES and the IES-2 total scores. IES-2 total scores were positively related to body appreciation, self-esteem, and satisfaction with life ($p < 0.01$). IES was inversely related to eating disorder symptomatology, poor interoceptive awareness, body surveillance, body shame, and internalization of media appearance ideals ($p < 0.01$).	IES-2 scores were unrelated or negligibly related to social desirability for women ($p = 0.4$) and men ($p = 0.1$).	4

The Dutch Eating Behaviour Questionnaire (DEBQ)						
31	(van Strein et al., 1986)	α (0.80 to 0.95)	$\alpha=0.94$ (0.65 to 0.84) (Banasiak et al., 2001)	Construct validity: Positive correlations between emotional and external eating and weak relationships between restraint and external eating. Similar results have been replicated in (Cebolla et al., 2014; J Wardle, 1987a).	Existent data but unavailable as only included in a publication when DEBQ is purchased for use (van Strein, 2002).	4
The Children's Dutch Eating Behaviour Questionnaire (DEBQ - C)						
32	(van Strein & Oosterveld, 2008)	α (0.73 to 0.82)	(Baños et al., 2011) (1 month) DEBQ-C-EE $\alpha=0.39$ (0.22-0.54), DEBQ-C-R $\alpha=0.71$ (0.61-0.79), DEBQ-C-ExtE $\alpha=0.64$ (0.52-0.74).	Construct validity: In both sexes DEBQ-C-EE and DEBQ-C-ExtE was significantly interrelated ($p<0.01$), but DEBQ-C-R was not associated with either DEBQ-C-EE and DEBQ-C-ExtE (controlling for BMI and age).	-	3
Dutch Eating Behaviour Questionnaire parent version (DEBQ-P)						
33	(Braet & van Strein, 1997)	(Caccialanza et al., 2004) α (0.79 to 0.86)	-	Significant relationship between DEBQ-P-EE and DEBQ-P-ExtE and various nutritional parameters ($p<0.01$ to $p<0.001$).	-	2
Hunger Sensitivity Scale (HSS)						
34	(Walker et al., 2015)	S1: $\alpha=0.95$ S2: $\alpha=0.90$	S2: One month, $r=0.81$ ($p<0.001$)	HSS was significantly associated with TFEQ-H ($p<0.05$), TFEQ-D ($p<0.001$).	Absence of significant correlations with general anxiety, depression and anxiety sensitivity.	4
Child Eating Behaviour Questionnaire (CEBQ)						
35	(Wardle, Guthrie, et al., 2001)	α (0.74 to 0.91)	t (0.52 [EOE] & 0.64 [EUE] to 0.87)	(Carnell & Wardle, 2007) Behavioural validation: Higher SR was associated with lower intake in the EWH test, better average caloric compensation, slower eating and lower average total energy intake. Higher scores on FR were associated with faster eating rate and greater total energy intake. Higher scores on EF were associated with greater EWH intake, faster eating rate and greater total energy intake and a marginally significant association between higher EF and poorer average caloric compensation.	(Loh et al., 2013) See details below.	4

Baby Eating Behaviour Questionnaire (BEBQ)						
36	(Llewellyn, van Jaarsveld, et al., 2011)	α (0.73 to 0.81)	-	Construct validity: 'Satiety responsiveness' and 'slowness in eating' were positively correlated and the size of the correlation was only slightly smaller than in older children (0.52–0.67) (Wardle et al., 2001).	-	2
Self-report measure of the CEBQ for 13-year-old adolescents (CEBQ-self-report)						
37	(Loh et al., 2013)	0.48 to 0.76	0.72 to 0.90	-	The AVE values were greater than the R-squared values between the constructs between Phase 1 and Phase 2 models, indicating sufficient discriminant validity.	2
Flexible and Rigid Control Dimensions of Dietary Restraint						
38	(Westenhoefer, 1991)	Rigid control $\alpha=0.77$ Flexible control $\alpha=0.79$	(Westenhoefer et al., 1999) Scales measured at different time points	(Westenhoefer et al., 1999) Increased 'rigid control' is associated with increasing disinhibition ($p<0.001$). Increasing 'flexible control' is associated with decreasing disinhibition ($p<0.001$).	Discriminant analysis in a subgroup of moderately highly restrained eaters with either low or high disinhibition ($n= 1759$) revealed different sets of restraint behaviours and cognitions differentiate between high and low disinhibition.	4

S1, S2, S3, etc. = Study 1, Study 2, Study 3

AVE: Average variance extracted; BDI: Beck Depression Inventory; BIS: Behavioural Inhibition Scores; BULIT: Bulimia test; CBDS: Cognitive Behavioural Dieting Scale; EE: Emotional Eating; ExtE: External Eating; CR: Cognitive Restraint; DI: Dysregulation Inventory; GNS: General Neophobia Scale, LOC: Loss of control; MOE: Meanings of Eating Questionnaire; NCOG: Non-clinical overweight group; No LOC: No loss of control; NWG: Normal weight group; RSE: Rosenberg self-esteem scale; SCL-90-R: Symptom checklist; UE: Uncontrolled eating.

BEBQ: Baby Eating Behaviour Questionnaire; CEBQ: Child Eating Behaviour Questionnaire; CEBQ-self-report: Self-report measure of the CEBQ; CPEBQ: Chinese Preschoolers' Eating Behaviour Questionnaire; CoEQ: Control of Eating Questionnaire; DEBQ: Dutch Eating Behaviour Questionnaire; DEBQ-C: Children's Dutch Eating Behaviour Questionnaire; DEBQ-P: Dutch Eating Behaviour Questionnaire parent version; EAH-C: Eating in the Absence of Hunger; ecSI: ecSatter Inventory; EES: Emotional Eating Scale; EESQ: Eating in Emotional Situations Questionnaire; EES-C: Emotional Eating Scale; EITI: Eating Identity Type Inventory; EMAQ: Emotional Appetite Questionnaire; EPI-C: Eating Pattern Inventory for Children; FCQ-S and FCQ-T: State and Trait Food-Cravings Questionnaires; FCQ-T-r and FCQ-T-r: Brief version of the Food Craving Questionnaire-Trait; FSQ: food Situations Questionnaire; FNS: Food Neophobia Scale; FNS-C: Food Neophobia Scale for children; G-FCQ-T and G-FCQ-S: General index of food craving; HSS: Hunger Sensitivity Scale; ICFNS: Italian Food Neophobia Scale for children; IES: Intuitive Eating Scale; IES-2: Intuitive Eating Scale-2; IES-H: Intuitive Eating Scale-H; K-PEMS: Palatable Eating Motives Scale for kids; MES: Mindful Eating Scale; MOF: Meaning of Food Questionnaire; OTS: Overeating Tension Scales; PEMS: Palatable Eating Motives Scale; PFS: Power of Food Scale; MFES: Motivation for Eating Scale; TFEQ: Three Factor Eating Questionnaire; TFEQ-R18: Three Factor Eating Questionnaire revised version; Three Factor Eating Questionnaire revised version TFEQ-R21 _TFEQ-R18-V2.

Appendix 5.1 Published paper



Appetitive traits and relationships with BMI in adults: Development of the Adult Eating Behaviour Questionnaire



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ABSTRACT

The Child Eating Behaviour Questionnaire (CEBQ) is a validated parent-report measure of appetitive traits associated with weight in childhood. There is currently no matched measure for use in adults. The aim of this study was to adapt the CEBQ into a self-report Adult Eating Behaviour Questionnaire (AEBQ) to explore whether the associations between appetitive traits and BMI observed in children are present in adults. Two adult samples were recruited one year apart from an online survey panel in 2013 ($n = 708$) and 2014 ($n = 954$). Both samples completed the AEBQ and self-reported their weight and height. Principal component analysis (PCA) was used to derive 35 items for the AEBQ in Sample 1 and confirmatory factor analysis (CFA) was used to replicate the factor structure in Sample 2. Reliability of the AEBQ was assessed using Cronbach's α and a two week test-retest in a sub-sample of 93 participants. Correlations between appetitive traits measured by the AEBQ and BMI were calculated. PCA and CFA results showed the AEBQ to be a reliable questionnaire (Cronbach's $\alpha > 0.70$) measuring 8 appetitive traits similar to the CEBQ [Hunger (H), Food Responsiveness (FR), Emotional Over-Eating (EOE), Enjoyment of Food (EF), Satiety Responsiveness (SR), Emotional Under-eating (EUE), Food Fussiness (FF) and Slowness in Eating (SE)]. Associations with BMI showed FR, EF ($p < 0.05$) and EOE ($p < 0.01$) were positively associated and SR, EUE and SE ($p < 0.01$) were negatively associated. Overall, the AEBQ appears to be a reliable measure of appetitive traits in adults which translates well from the validated child measure. Adults with a higher BMI had higher scores for 'food approach' traits (FR, EOE and EF) and lower scores for 'food avoidance' traits (SR, EUE and SE).

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1. Introduction

The current obesity epidemic has reached widespread proportions, showing a combined increase in adult overweight and obesity prevalence of 27.5% worldwide between 1980 and 2013 (Ng et al., 2014). This is particularly concerning given that obesity is a major contributor to a number of physical and psychological health conditions, as well as increases in mortality (Flegal, Kit, & Orpana, 2013). There is therefore a desire to understand the mechanisms behind the aetiology of obesity.

At an individual level, factors such as food overconsumption and

decreases in physical activity are interacting to determine weight gain (Llewellyn & Wardle, 2015). These behaviours are thought to be influenced both by the environment and by genetically determined appetitive traits (Llewellyn, van Jaarsveld, Plomin, Fisher, & Wardle, 2012), defined as a set of stable predispositions towards food (Carnell, Benson, Pryor, & Driggin, 2013). The behavioural susceptibility theory of obesity (Llewellyn & Wardle, 2015) suggests that individual differences in these traits relate to susceptibility to gain weight (or not) in response to the current obesogenic environment.

The majority of studies exploring appetitive traits and weight have used validated and reliable questionnaires, which removes the costly obstacles of laboratory and neural measurements of appetite and makes data available for large populations (Carnell & Wardle, 2007). A considerable number of questionnaires have been used to measure appetite. The most widely used adult tools are the 'Three Factor Eating Questionnaire' (TFEQ) (Stunkard & Messick,

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¹ In memory of Professor Jane Wardle (1950–2015).

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1985) and the 'Dutch Eating Behaviour Questionnaire' (DEBQ) (Van Strein, Frijters, Bergers & Defares, 1986); and with children, the Child Eating Behaviour Questionnaire (CEBQ) (Wardle, Guthrie, Sanderson, & Rapoport, 2001). These 3 questionnaires have improved understanding of the individual appetitive traits that increase a person's risk of weight gain or resistance to weight loss. However, although important in their own right, neither the TFEQ nor the DEBQ capture all of the specific traits measured by the CEBQ, a parent-report questionnaire validated for use with children between the ages of 3 and 13 years.

The CEBQ measures 8 appetitive traits; 4 'food approach' traits; Food Responsiveness (FR), Emotional Over-Eating (EOE) and Enjoyment of Food (EF), Desire to Drink (DTD) and 4 'food avoidance' traits; Satiety Responsiveness (SR), Emotional Under-Eating (EUE), Food Fussiness (FF) and Slowness in Eating (SR). In contrast, the DEBQ captures 3 aspects of eating (Emotional Eating, Restraint and External Eating) and the TFEQ captures Cognitive Restraint, Disinhibition and Hunger. Although the DEBQ does include an emotional eating scale, unlike the CEBQ, it does not contain separate sub-scales for emotional over-eating and emotional under-eating. Similarly the Disinhibition scale of the TFEQ incorporates items relating to both emotional eating and food responsiveness, rather than treating them as distinct constructs.

Numerous studies have demonstrated that the 'food approach' traits captured by the CEBQ are positively correlated with weight in childhood (Croker, Cooke, & Wardle, 2011; Santos et al., 2011; Sleddens, Kremers, & Thijs, 2008) whereas, children who score highly on 'food avoidance' traits are less susceptible to overeating, and have lower weight (Fuemmeler, Lovelady, Zucker, & Ostbye, 2013; Spence, Carson, Casey, & Boule, 2011; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009). Longitudinal studies using the CEBQ also provide support for the hypothesis that these appetitive traits contribute to weight gain rather than the other way around (Van Jaarsveld, Llewellyn, Johnson, & Wardle, 2011).

There is some evidence from studies using the CEBQ that appetitive traits vary with age (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008). However, studies exploring changes in appetitive traits across the life course have been limited by the lack of a matched self-report measure of these specific appetitive traits for adults. Food Responsiveness and Satiety Responsiveness have particularly strong relationships with weight in children, but neither is adequately captured by existing measures of appetite in adulthood. Measurement of these traits in adults would contribute to our understanding of how these specific traits influence weight gain at older ages (French, Epstein, Jeffery, Blundell, & Wardle, 2012).

There is already a Baby Eating Behaviour Questionnaire (BEBQ) (Llewellyn, van Jaarsveld, Johnson, Carnell, & Wardle, 2011) that enables the measurement of the traits assessed by the CEBQ in infants. The addition of an Adult Eating Behaviour Questionnaire (AEBQ) would provide the field with three life-stage appropriate measurement instruments that assess the same eating behaviours. This would make it possible to longitudinally track appetitive traits from infancy (BEBQ) and childhood (CEBQ) into adulthood (AEBQ), to give a better picture of the association between appetitive traits and weight across the life-course. Scores on an AEBQ could also be used to inform interventions to help individuals to control their weight, by providing tailored feedback on managing appetitive trait responses. It may also enable identification of individuals at risk of weight gain to inform targeted obesity prevention efforts.

The aim of this study was therefore to adapt the parent-report 'Children's Eating Behaviour Questionnaire' into a psychometrically valid self-report 'Adult Eating Behaviour Questionnaire', and to explore whether relationships between appetitive traits and BMI observed in children can also be seen in an adult sample.

2. Methods

2.1. Development of the Adult Eating Behaviour Questionnaire

Generation of items: The 35 items from the CEBQ were changed from the "My child ..." format to a self-complete "I ..." format (e.g. "My child loves food" was changed to "I love food") and the original response options ('never', 'rarely', 'sometimes', 'often' and 'always') were retained. Ten researchers working in the area of Energy Balance completed the self-report version of the CEBQ and discussed their experiences. The researchers described how the Desire to Drink scale was difficult to complete. Items from the CEBQ such as "My child is always asking for a drink" had been adapted to "I am always asking for a drink" for the AEBQ and it became unclear what type of drink (i.e. alcoholic versus non-alcoholic) was being referred to. Additionally, the item "My child is always asking for food" from the FR construct in the CEBQ, which became "I am always asking for food" in the AEBQ, was difficult for adults to relate to. It was therefore agreed that the 3 items from the Desire to Drink scale, and the "I am always asking for food item" from the FR scale should be eliminated.

Further refinement of the questionnaire took place in 3 group discussions with a panel of clinical psychologists, behavioural scientists, dieticians, and authors of the original CEBQ. The panel initially reviewed the remaining items from the original CEBQ for any obvious gaps or additional problem areas. It was suggested that a measure of hunger experience (H), which could not be captured by the CEBQ because parents are unable to accurately determine their child's experienced level of hunger, should be added (Wardle et al., 2013). It was also agreed that aspects of Food Responsiveness that related to food cues a parent would not have been able to comment on should also be included. Following this discussion, potential items for the Hunger scale were identified for review, and additional items for the Food Responsiveness scale were developed by the authors for piloting. Finally the panel reviewed all included and excluded items to ensure no further additions/removals were felt to be required. A group consensus was reached and the total number of items following these additions, and the removal of the Desire to Drink scale, was 49.

Piloting. The extended version of the AEBQ was piloted online in an opportunity sample of 49 adults (21–73 years old), 36 women (79.6%) and 13 men (20.4%). Colleagues at University College London were asked to circulate a link to the questionnaire to their friends and family from a range of professional backgrounds. Participants were invited to comment on each individual item and on the questionnaire as a whole. Piloting led to changes in the response options from 'never', 'rarely', 'sometimes', 'often' and 'always', to 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree' because participants commented that the original response options did not fit with the questions. The new response options were tested with a small convenience sample (two females and three males, aged 31 ± 7 years). This answer format appeared to be more meaningful and better understood by this sample.

Piloting also led to the deletion of the item "Given the choice, I would always have food in my mouth" because several participants commented that it "sounded a bit odd" or was "over the top". A second item ("I am interested in food") was eliminated because participants reported they found the meaning ambiguous. The remaining 47 item version of the AEBQ was included in the Principal Component Analysis (PCA).

2.2. Assessing the factor structure of the Adult Eating Behaviour Questionnaire

Samples. Two samples of adults aged 18 or over [Sample 1

(2013) and Sample 2 (2014) were recruited one year apart, from an online provider of sampling and data collection for survey research (Research Now). Research Now holds a panel of over 200,000 UK residents who have consented to answer online questionnaires. Ethical approval was granted by University College London Research Ethics Committee.

Measures. Participants provided demographic information on ethnicity, level of education, working status, and income, in addition to completing the 47 item AEBQ. Self-reported weight and height measures were obtained for BMI calculation.

Analysis. PCA was used to uncover the underlying structure of the AEBQ from Sample 1 responses (Field, 2013) using SPSS version 22.0. All AEBQ items showed high inter-correlation greater than 0.3, but no multi-collinearity was observed. Data were extracted using oblimin rotation to allow for correlation between components and eigenvalues above 1 were retained. There were no missing cases for the scales. An iterative process was used to gradually remove items that had unacceptable factor loadings (<0.3), or that loaded highly onto two components. Items with factor loadings above 0.3 were retained because these are considered statistically meaningful with a large sample size (Field, 2013).

Confirmatory factor analysis (CFA) was carried out on responses from Sample 2 by specifying the model obtained from the PCA in Sample 1 (Model 1), using SPSS AMOS version 22.0. We looked at modification indices and covariances of error terms on the same factors (component in PCA) to test different models. Model fit was assessed using the following indices: root mean-square error of approximation (RMSEA); chi-square test (χ^2); normed fit index (NFI) and comparative fit index (CFI). Smaller values for RMSEA (ideally ≤ 0.06) and values approaching 0.90 for NFI and CFI (ideally > 0.90) are indicative of good model fit (Hu & Bentler, 1999). The Chi-square test is a measure of the difference between observed and expected covariance matrices and should be non-significant. However, the Chi-square test readily reaches significance with large sample sizes even when all other indices indicate a good fit (Dugard, Todman, & Staines, 2010). Lower AIC (Akaike's Information Criteria) and BIC (Bayesian Information Criterion) values were used to select the best fitting model (Dugard et al., 2010). Cronbach's alphas were also calculated for each of the scales obtained from the best model fit to assess the internal consistency of the AEBQ. Cronbach's alphas greater than 0.70 were accepted as a good measure of consistency for each appetitive trait (Field, 2013). Individual mean scores were calculated for each of the AEBQ scales obtained after CFA on the whole Sample 2.

Test re-test reliability of the AEBQ was assessed by repeating it in a sub-sample of 93 participants [19 males (20.4%) and 74 females (79.6%)] two weeks after initial completion. The sub-sample were selected at random from Sample 2 by Research Now and invited to complete the online questionnaire a second time. The test re-test reliability of the measure was assessed using Intra-Class Correlation coefficients (ICC) (McGraw & Fleiss, 1996) and Cronbach's alpha measurements based on the average inter-item correlations (Field, 2013).

Correlations between scales and BMI in Sample 2 were determined using Pearson's correlation coefficient for normally distributed scales and Spearman's rho for non-normally distributed scales.

3. Results

The AEBQ was initially completed by 708 adults aged 18–81 years (Sample 1; see Table 1). Sample 1 had a mean age of 39 ± 17 , with a mean BMI of 26.10 ± 5.81 . One year later the AEBQ was completed by a second sample of 954 adults aged between 18 and 79 (Sample 2; see Table 1). The mean age of Sample 2 was 44 ± 13

and the mean BMI was 26.07 ± 5.80 . A sub-sample of 93 participants from Sample 2 (mean age 49 ± 13 ; see Table 1) completed the AEBQ a second time two weeks later to assess test-retest reliability. Both samples were mostly white (Sample 1: 90.3%, Sample 2: 90.5%), and the majority of participants were female (Sample 1: 52.5%, Sample 2: 57.3%) (see Table 1).

3.1. Principal Component Analysis

PCA revealed a 35 item questionnaire which loaded onto 7 components. Twelve items from the original 47 were excluded through the iterative process. Each remaining item had the highest loading on to a single component [except for 'I often feel hungry when I am with someone who is eating' which loaded onto the Food Responsiveness construct and also Enjoyment of Food (0.31) (Table 2)], and explained the highest variance. The 7 components encompassed three 'food approach' scales and four 'food avoidance' scales. The 'food approach' scales were: Hunger and Food Responsiveness (which loaded onto a single component), Emotional Over-Eating, and Enjoyment of Food. The four 'food avoidance' scales were: Satiety Responsiveness, Emotional Under-Eating, Food Fussiness and Slowness in Eating. These 7 components had an average communality of 0.64 and explained 64.27% of the variance. The final model fit the data well and resembled the CEBQ (Table 2) (Appendix 1).

3.2. Confirmatory factor analysis

The 35 AEBQ items were entered into a 7 factor CFA, where indicators (items) of each factor (component) loaded onto their own factor, based on the PCA results (Model 1). All factor loadings were > 0.3 : Hunger and Food Responsiveness together (0.39–0.76), Emotional Over-Eating (0.70–0.88), Enjoyment of Food (0.72–0.89), Satiety Responsiveness (0.57–0.83), Food Fussiness (0.71–0.89) and Slowness in Eating (0.71–0.90). This resulted in a relatively decent model fit (RMSEA = 0.06, NFI = 0.87, CFI = 0.90, $\chi^2(df = 539) = 2431.35$, $p < 0.001$) (Hu & Bentler, 1999). After examining the modification indices and the co-varied error terms with the largest parameter changes that were part of the same factor, unexplained correlations relating to the combined Hunger and Food Responsiveness factor were identified (Dugard et al., 2010). Therefore Hunger and Food Responsiveness were split into two separate factors and each indicator was allowed to only load on to their respective factor (factor loadings ranged from 0.44 (*If my meals are delayed I get light-headed*) to 0.79 (*I often feel hungry*) for Hunger and from 0.55 (*When I see or smell food that I like, it makes me want to eat*) to 0.72 (*Given the choice, I would eat most of the time*) for Food Responsiveness). The 8 factor model (Model 2) produced a better model fit (RMSEA = 0.06, CFI = 0.91, $\chi^2(df = 532) = 2254.66$, $p < 0.001$) and lower AIC and BIC values (Table 3).

Cronbach's alphas for each of the 8 scales were greater than 0.70 (range 0.75–0.90) indicating good internal reliability. Measures of test-retest reliability in the subsample of 93 participants also revealed good external reliability with all Cronbach's alpha values greater than 0.70 (α : 0.73–0.91) (Field, 2013) (Table 4). Overall, the scales correlated with each other in the expected direction; 'food approach' scales were positively correlated with each other and negatively correlated with 'food avoidance' scales, and 'food avoidance' scales were positively correlated with each other (Table 5).

3.3. Associations with BMI

All of the scale values were normally distributed except for Enjoyment of Food which was skewed to the right. Results are

Table 1
Descriptive statistics of adult samples used to carry out PCA (Sample 1) and CFA and re-test sample (Sample 2).

	Sample 1	Sample 2	
	PCA (n = 708)	CFA (n = 954)	Re-test (n = 93)
	n (%)	n (%)	n (%)
Age			
18 to 29	301 (42.5%)	166 (17.4%)	9 (9.7%)
30 to 59	300 (42.4%)	654 (68.6%)	59 (63.4%)
60+	107 (15.1%)	134 (14.0%)	25 (26.9%)
Gender			
M	336 (47.5%)	407 (42.7%)	19 (20.4%)
F	372 (52.5%)	547 (57.3%)	74 (79.6%)
BMI^a			n = 90
Underweight	30 (4.4%)	25 (2.7%)	2 (2.2%)
Normal weight	328 (48.7%)	380 (39.8%)	40 (44.4%)
Overweight	173 (25.6%)	278 (29.1%)	25 (27.8%)
Obese	143 (21.2%)	257 (26.9%)	23 (24.7%)
Ethnicity			
White	635 (90.3%)	863 (90.5%)	91 (97.8%)
Non-white	68 (9.7%)	91 (9.5%)	2 (2.2%)
Education			
Finished primary/secondary school or O level/GCSE ^b	179 (25.6%)	243 (25.5%)	28 (30.1%)
A levels or technical or trade certificate or diploma	242 (34.6%)	359 (37.6%)	29 (31.2%)
University	279 (39.9%)	352 (36.9%)	36 (38.7%)

^a Participants who reported a BMI <14 or >50 were excluded as these values were felt to be unrealistic.

^b General Certificate of Secondary Education.

presented for participants with BMIs greater than 14 and lower than 50, as this range was felt to reflect realistic values. Results showed small positive correlations between BMI and the 'food approach' scales; Food Responsiveness, Emotional Over-Eating and Enjoyment of Food; participants with higher BMI values scored higher on these scales. Small negative correlations were observed between BMI and the 'food avoidance' scales; Satiety Responsiveness, Emotional Under-Eating and Slowness in Eating. No relationships were found between BMI and either Hunger or Food Fussiness (Table 6).

4. Discussion

This is the first study to measure appetitive traits using the AEBQ, a new reliable self-report measure of appetitive traits in adulthood. Correlations between appetitive traits and BMI showed that adults with higher BMIs scored higher for Food Responsiveness, Emotional Over-Eating and Enjoyment of Food and lower for Satiety Responsiveness, Emotional Under-Eating and Slowness in Eating.

The AEBQ differs from the CEBQ in several ways including the addition of a Hunger scale and the removal of the Desire to Drink scale. However because the CEBQ is used as a set of subscales rather than as a single scale, this should not impact the ability to use the AEBQ in longitudinal studies with both the CEBQ and the BEBQ. Although such studies will not be able to measure Desire to Drink in adults, nor Hunger in children, the 7 remaining scales are the same across the two questionnaires. Importantly those traits found to have the strongest relationships with weight in childhood (Food Responsiveness and Satiety Responsiveness) are retained in the AEBQ.

The Desire to Drink scale was eliminated after piloting as it was deemed unsuitable for adult samples. Previous studies have reported no relationship between the CEBQ Desire to Drink scale and weight in children aged 3–13 (Santos et al., 2011; Sleddens et al., 2008; Sweetman, Wardle, & Cooke, 2008; Viana, Sinde, & Saxton, 2008), or in Malaysian adolescents who completed a self-report

version of the CEBQ (Loh, Moy, Zaharan, & Mohamed, 2013). Therefore, the exclusion of this scale from the AEBQ is unlikely to be of significance for studies seeking to explore the association between appetitive traits and weight in older samples.

Hunger may be seen as an important aspect of appetite that was omitted from the CEBQ because of the parent-report nature of the questionnaire. However, while a Hunger scale was added to the AEBQ because adults can report their own experienced levels of hunger, this scale was not associated with weight. The new Hunger scale is a measure of physical hunger (e.g. stomach rumbles) unrelated to emotional or restraining situations as measured in the revised and shortened TFEQ (TFEQ- R18) (Karlsson, Persson, Sjöström, & Sullivan, 2000; Stunkard & Messick, 1985). It is possible that people find it difficult to assess their level of physical hunger, perhaps due to its relationship to forms of disinhibition and issues with eating regulation (Karlsson et al., 2000). It is also likely that individuals differ in their perception and interpretation of what hunger actually means (Wardle, 1987). As seen in the factor loadings and the correlations between the scales, the relationship between Hunger and Food Responsiveness was strong, although the CFA ultimately revealed separating these scales provided the best model fit. While Hunger and Food Responsiveness appear to be overlapping constructs, substantial literature exists which distinguishes them as separate dimensions of eating (Meyer & Pudel, 1972; Schachter & Gross, 1968; Schachter, 1968; Stunkard & Fox, 1971). Future studies using the AEBQ should consider whether it is important to retain the Hunger scale as an important appetitive trait in adults.

The eight AEBQ scales were found to have good internal reliability (α : 0.762 to 0.881) (Field, 2013), in line with the CEBQ (Ashcroft et al., 2008) and the infant version, the BEBQ (Llewellyn et al., 2011). The AEBQ scales also showed good test-retest reliability (ICCs: 0.732 to 0.910), comparable to most CEBQ scales with the exception of Emotional Over-Eating and Emotional Under-Eating (Wardle et al., 2001), which appear to be more stable in adults. As with the CEBQ and BEBQ (Llewellyn et al., 2011; Wardle et al., 2001), positive correlations were observed between the four

Table 2
Factor loadings of a 35 item AEBQ (Sample 1, n = 708).

	Eigenvalue (% variance explained)	Components determined through PCA ^a						
		1 H + FR	2 SR	3 EUE	4 FF	5 EOE	6 EF	7 SE
I often notice my stomach rumbling		0.752						
I often feel so hungry that I have to eat something right away		0.737						
I often feel hungry		0.69						
If my meals are delayed I get light-headed		0.66						
If I miss a meal I get irritable	6.638 (19%)	0.545						
I am always thinking about food		0.56						
Given the choice, I would eat most of the time		0.477						
I often feel hungry when I am with someone who is eating		0.401					0.307	
When I see or smell food that I like, it makes me want to eat		0.355						
I get full up easily			0.778					
I cannot eat a meal if I have had a snack just before	5.301 (15.15%)		0.753					
I often leave food on my plate at the end of a meal			0.612					
I often get full before my meal is finished			0.611					
I eat less when I'm annoyed				0.838				
I eat less when I'm worried	3.264 (9.33%)			0.835				
I eat less when I'm anxious				0.827				
I eat less when I'm upset				0.825				
I eat less when I'm angry				0.756				
I refuse new foods at first					-0.826			
I am interested in tasting new food I haven't tasted before*				0.815				
I often decide that I don't like a food, before tasting it	2.868 (8.2%)				-0.791			
I enjoy tasting new foods*				0.767				
I enjoy a wide variety of foods*				0.692				
I eat more when I'm upset					-0.871			
I eat more when I'm worried	1.829 (5.23%)				-0.860			
I eat more when I'm anxious					-0.830			
I eat more when I'm annoyed					-0.814			
I eat more when I'm angry					-0.717			
I enjoy eating	1.368 (3.91%)						0.854	
I love food							0.831	
I look forward to mealtimes							0.814	
I eat slowly								-0.899
I am often last at finishing a meal	1.206 (3.45%)							-0.869
I often finish my meals quickly*								0.775
I eat more and more slowly during the course of a meal								-0.672

^aItems should be reverse scored when calculating scale means and Chronbach's alphas; ^{*}Factor loadings above 0.3 are presented; H, 'hunger'; FR, 'food responsiveness'; EOE, 'emotional over-eating'; EF, 'enjoyment of food'; SR, 'satiety responsiveness'; EUE, 'emotional under-eating'; FF, 'food fussiness'; SE, 'slowness in eating'

'food approach' scales (H, FR, EOE and EF), and between the four 'food avoidance' scales (SE, EUE, SE and FF only with SR) of the AEBQ, while generally negative correlations were observed between the different types of scales.

The relationships between appetitive traits and BMI observed in this adult sample are similar to findings from the child literature where adiposity is consistently positively associated with 'food approach' scales and negatively associated with 'food avoidance'

scales of the CEBQ (Mallan et al., 2013; Santos et al., 2011; Sleddens et al., 2008; Viana et al., 2008; Webber et al., 2009). Although the direction of associations in this study replicates those from studies in children using the CEBQ, they were more modest in our sample of adults. This may be indicative of appetitive traits exerting a differential influence on weight across the life course. Furthermore, adults may actively restrict their energy intake in an attempt to control their weight, which could suppress the impact of certain

narrow sample of people from similar ethnic and social backgrounds; although we had a good mix of educational levels, our sample was predominantly white. Weight and height measurements were self-reported, which may have led to over-estimation of height and under-reporting of weight (Gorber, Tremblay, Moher, & Gorber, 2007), potentially explaining why associations between BMI and appetitive traits were small. The cross-sectional nature of the study precludes any inferences about causation.

Although we established the factor structure, internal consistency, and test-retest reliability of the AEBQ, there was no comparison against behavioural measures of eating to assess validity. The CEBQ has been validated against several aspects of eating behaviour (including eating without hunger, caloric compensation, eating rate and energy intake at a meal) (Carnell & Wardle, 2007). Given the AEBQ is adapted from the CEBQ and has a similar factor structure there is no reason to believe its validity would differ, however this should be confirmed in future studies. Finally, as participants may have been aware that eating behaviours are related to weight, some individuals may have felt the need to respond to the AEBQ in a socially desirable way (Carnell & Wardle, 2008; Carnell et al., 2013).

In sum, the AEBQ, a self-report measure of appetitive traits in adults, is a reliable instrument, and provides a comprehensive, convenient, and easy-to-use measure of an adult's appetite. The development of the AEBQ is an important step that permits large-scale research into key appetitive traits in adults, which are related to weight in infant and child populations. The relationships

between appetitive traits and BMI in adulthood in this study were comparable to those observed in children, indicating that approach-related and avoidance-related appetitive traits are systematically (and oppositely) associated with BMI across the life-course. Future research should seek to replicate these findings in larger samples and using longitudinal designs, and to explore the potential for the AEBQ to inform weight control interventions.

The scoring system of the AEBQ can be downloaded from the following website: http://www.ucl.ac.uk/hbrc/resources/resources_eb.

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Appendix 1. AEBQ items compared to the original CEBQ items.

AEBQ	Item source	AEBQ item	CEBQ item
H	New	I often feel so hungry that I have to eat something right away	
	New	I often notice my stomach rumbling	
	New	If I miss a meal I get irritable	
	New	If my meals are delayed I get light-headed	
	New	I often feel hungry	
FR	New	I often feel hungry when I am with someone who is eating	
	New	When I see or smell food that I like, it makes me want to eat	
	CEBQ (FR)	Given the choice, I would eat most of the time	Given the choice, my child would eat most of the time
	NI	–	Even if my child is full up s/he finds room to eat his/her favourite food
	NI	–	If given the chance, my child would always have food in his/her mouth
EOE	CEBQ (FR)	I am always thinking about food	My child is always asking for food
	NI	–	If allowed to, my child would eat too much
	CEBQ (EOE)	I eat more when I'm annoyed	My child eats more when annoyed
	CEBQ (EOE)	I eat more when I'm worried	My child eats more when worried
	New	I eat more when I'm upset	NI
EF	CEBQ (EOE)	I eat more when I'm anxious	My child eats more when anxious
	New	I eat more when I'm angry	NI
	NI	–	My child eats more when s/he has nothing else to do
	CEBQ (EF)	I love food	My child loves food
	CEBQ (EF)	I look forward to mealtimes	My child looks forward to mealtimes
SR	CEBQ (EF)	I enjoy eating	My child enjoys eating
	NI	–	My child looks forward to mealtimes
	CEBQ (SR)	I often leave food on my plate at the end of a meal	My child leaves food on his/her plate at the end of a meal
	CEBQ (SR)	I often get full before my meal is finished	My child gets full before his/her meal is finished
	CEBQ (SR)	I get full up easily	My child gets full up easily
EUE	CEBQ (SR)	I cannot eat a meal if I have had a snack just before	My child cannot eat a meal if s/he has had a snack just before
	NI	–	My child has a big appetite ^a
	New	I eat less when I'm worried	
	CEBQ (EUE)	I eat less when I'm angry	My child eats less when angry
	CEBQ (EUE)	I eat less when I'm upset	My child eats less when upset
FF	New	I eat less when I'm annoyed	
	New	I eat less when I'm anxious	
	NI	–	My child eats more when she is happy
	NI	–	My child eats less when s/he is tired
	CEBQ (FF)	I refuse new foods at first	My child refuses new foods at first
FF	CEBQ (FF)	I am difficult to please with meals	My child is difficult to please with meals
	CEBQ (FF)	I often decide that I don't like a food, even without tasting it	My child decides that s/he doesn't like a food, even without tasting it
	CEBQ (FF)	I enjoy tasting new foods ^a	My child enjoys tasting new foods ^a
	CEBQ (FF)	I am interested in tasting food I haven't tasted before ^a	My child is interested in tasting food s/he hasn't tasted before ^a
	NI	–	My child enjoys a wide variety of foods ^a

(continued)

AEBQ	Item source	AEBQ item	CEBQ item
SE	CEBQ (SE)	I eat slowly	My child eats slowly
	CEBQ (SE)	I am often last at finishing a meal	My child takes more than 30 min to finish a meal
	CEBQ (SE)	I eat more and more slowly during the course of a meal	My child eats more and more slowly during the course of a meal
	CEBQ (SE)	I often finish my meal (s) quickly ^a	My child finishes his/her meal quickly ^a

H, 'hunger'; FR, 'food responsiveness'; EOE, 'emotional over-eating'; EF, 'enjoyment of food'; SR, 'satiety responsiveness'; EUE, 'emotional under-eating'; FF, 'food fussiness'; SE, 'slowness in eating'.

Response options for the CEBQ: 'never', 'rarely', 'sometimes', 'often' and 'always'.

Response options for the AEBQ: 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree'.

^a Indicates item should be reverse scored for calculating scale means or Chronbach's alphas.

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Appendix 5.2 Conference presentations

Hunot C., Beeken R.J., Croker H., Wardle J. Development of the 'adult eating behaviour questionnaire' for appetitive trait measurement. *Obesity Facts* 2015;8(suppl 1):89-90. Poster at the European Conference on Obesity (ECO 2015), Prague, Czech Republic.

Hunot C., Beeken R.J., Croker H., Klienman N., Wardle J. Associations between appetitive traits and weight in adults in Britain. *Obesity Facts* 2015;8(suppl 1):85-86. Poster at the European Conference on Obesity (ECO 2015), Prague, Czech Republic.

Hunot C., Beeken R.J., Croker H., Wardle J. Development of the 'adult eating behaviour questionnaire' for appetitive trait measurement. Oral presentation at the XIII Symposium of Mexican Students and Studies. July 24th 2015. University College London, UK.

Appendix 5.3 The Child Eating Behaviour Questionnaire (CEBQ)

ID:

Child Eating Behaviour Questionnaire (CEBQ)

Please read the following statements and tick the boxes most appropriate to your child's eating behaviour.

	Never	Rarely	Some -times	Often	Always	
My child loves food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EF
My child eats more when worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EOE
My child has a big appetite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SR*
My child finishes his/her meal quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SE*
My child is interested in food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EF
My child is always asking for a drink	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DD
My child refuses new foods at first	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF
My child eats slowly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SE
My child eats less when angry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EUE
My child enjoys tasting new foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF*
My child eats less when s/he is tired	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EUE
My child is always asking for food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FR
My child eats more when annoyed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EOE
If allowed to, my child would eat too much	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FR
My child eats more when anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EOE
My child enjoys a wide variety of foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF*
My child leaves food on his/her plate at the end of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SR
My child takes more than 30 minutes to finish a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SE

	Never	Rarely	Some -times	Often	Always	
Given the choice, my child would eat most of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FR
My child looks forward to mealtimes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EF
My child gets full before his/her meal is finished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SR
My child enjoys eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EF
My child eats more when she is happy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EUE
My child is difficult to please with meals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF
My child eats less when upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EUE
My child gets full up easily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SR
My child eats more when s/he has nothing else to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EOE
Even if my child is full up s/he finds room to eat his/her favourite food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FR
If given the chance, my child would drink continuously throughout the day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DD
My child cannot eat a meal if s/he has had a snack just before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SR
If given the chance, my child would always be having a drink	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DD
My child is interested in tasting food s/he hasn't tasted before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF*
My child decides that s/he doesn't like a food, even without tasting it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FF
If given the chance, my child would always have food in his/her mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	FR
My child eats more and more slowly during the course of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SE

SCORING OF THE CEBQ

(Never=1, Rarely=2, Sometimes=3, Often=4, Always=5)

Food responsiveness	=	item mean FR
Emotional over-eating	=	item mean EOE
Enjoyment of food	=	item mean EF
Desire to drink	=	item mean DD
Satiety responsiveness	=	item mean SR
Slowness in eating	=	item mean SE
Emotional under-eating	=	item mean EUE
Food fussiness	=	item mean FF

*Reversed items

Wardle, J, Guthrie CA, Sanderson, S and Rapoport, L. Development of the Children's Eating Behaviour Questionnaire. *Journal of Child Psychology and Psychiatry*. **42**, 2001, 963-970.

NB: There is an error in the text of this paper concerning the scoring of the CEBQ which is given as 0 - 4. In fact responses were scored 1- 5 and the means and standard deviations given in the tables reflect this.

http://www.ucl.ac.uk/hbrc/resources/resources_eb

Appendix 5.4 Weight Concern ‘Shape-Up’ manual ‘hunger’ or ‘craving’ questions



Craving or hunger?

Which of the following eating temptations are cravings, and which are hunger? *Answers below.*

	Craving	Hunger
1 You have eaten a large meal, but still want pudding.	<input type="checkbox"/>	<input type="checkbox"/>
2 Someone mentions iced buns, and you feel like eating.	<input type="checkbox"/>	<input type="checkbox"/>
3 You are always starving at certain times of the day.	<input type="checkbox"/>	<input type="checkbox"/>
4 You feel light-headed after not eating all day.	<input type="checkbox"/>	<input type="checkbox"/>
5 You drive by a chip shop and the smell makes you want to eat.	<input type="checkbox"/>	<input type="checkbox"/>
6 Your stomach is rumbling.	<input type="checkbox"/>	<input type="checkbox"/>
7 You are watching a cookery programme and feel like eating something.	<input type="checkbox"/>	<input type="checkbox"/>
8 Your friend offers you half of her sandwich. You suddenly want to eat more.	<input type="checkbox"/>	<input type="checkbox"/>
9 You haven't thought about eating today and you are getting the shakes.	<input type="checkbox"/>	<input type="checkbox"/>

- Stop and think. Are you really hungry or is this just an urge or craving?
- Are you thirsty rather than hungry?

2 SURFING THE URGE

You might have thought that you are the least likely person to outlast an urge to eat. Most people believe that the urge will get worse and worse so that eventually they will cave in. However, psychologists who have studied people who think they are addicted to a whole range of things, such as smoking, have found that this is not the case.

Answers: 1, 2, 5 and 7 are usually cravings; 4, 6 and 9 signal hunger; 3 and 8 could be either.

MODULE 5
GAINING CONTROL
OF EATING

- 1 GETTING READY TO GAIN MORE CONTROL OF YOUR EATING
- 2 UNDERSTANDING YOUR OVEREATING
- 3 GETTING INTO A REGULAR EATING PATTERN
- 4 DEALING WITH EPISODES OF OVEREATING OR BINGE EATING
- 5 WHAT ELSE CAN HELP?

Source: (Wardle, Liao, et al., 2001)

Appendix 5.5 'Adult Eating Behaviour Questionnaire' used for piloting (49-item) in Study 2, Chapter 5**Adult Eating Behaviour Questionnaire (AEBQ)**

1.

Thank you for your interest in our research. As you know, the aim of this research is to validate a questionnaire that can be used to identify adult's eating behaviours. This study has been approved by the UCL Research Ethics Committee (Project ID Number): 4378/001. In total the survey will take about 10 minutes of your time to complete.

All responses to this questionnaire are anonymous, so we won't be able to respond directly to any answers. If you are worried about your eating behaviours, then please talk to your GP. For advice on healthy eating, please see the Weight Concern website: www.weightconcern.org.uk

If you have any further questions about the study, please do not hesitate to send an email to Claudia Hunot: c.hunot.12@ucl.ac.uk.

If you are happy to take part, please click on "Next" below. By clicking on "Next" you are agreeing that:

- You have read the notes written above and you understand what the survey involves.
- You understand that as your participation is anonymous it will not be possible for us to withdraw your responses once you have completed the survey.
- The project has been explained to you and that you agree to take part in the survey.

Adult Eating Behaviour Questionnaire (AEBQ)

2.

* What is your gender?

- Male
- Female

Adult Eating Behaviour Questionnaire (AEBQ)

3.

* What is your current age?

Adult Eating Behaviour Questionnaire (AEBQ)

4.

* What is your current weight approximately? Please state in stones, pounds or kilograms.

Stones and pounds

Kilograms

Adult Eating Behaviour Questionnaire (AEBQ)

5.

* What is your current height approximately? Please state in feet and inches or centimeters.

Feet and inches

Centimeters

Adult Eating Behaviour Questionnaire (AEBQ)

6.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
I love food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see or smell food that I like, it makes me want to eat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I leave food on my plate at the end of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always hungry at certain times of the day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a big appetite	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy tasting new foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

7.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
I am interested in food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I allowed myself, I would eat too much	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I notice my stomach rumbling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat slowly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I am happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy a wide variety of foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm bored	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I easily get full up	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

8.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
I feel hungry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more and more slowly during the course of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I refuse new foods at first	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am interested in tasting food I haven't tasted before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

9.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
If my meals are delayed I get light-headed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am difficult to please with meals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm bored	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I decide that I don't like a food, even without tasting it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Given the choice, I would eat most of the time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am last at finishing a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I cannot eat a meal if I have had a snack just before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

10.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
I eat less when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I finish my meals quickly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I am tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Even if I am full up I find room to eat my favourite food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get full before my meal is finished	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I look forward to mealtimes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

11.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated.

* Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Never	Rarely	Sometimes	Often	Always
If I miss a meal I get irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Given the chance, I would always have food in my mouth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think about food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel so hungry that I have to eat something right away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel hungry when I am with someone who is eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire (AEBQ)

12.

If you are happy about answering a number of questions about the survey in a couple of week's time, please write your email address below.

Adult Eating Behaviour Questionnaire (AEBQ)

13.

We understand that questions are duplicative. We are using this process to filter out questions that will be eliminated. On this basis, do you still find any questions to be odd? Do you think any of the questions are unnecessary? We would really appreciate your comments.

Adult Eating Behaviour Questionnaire (AEBQ)

14.

All responses to this questionnaire are anonymous, so we won't be able to respond directly to any answers. If you are worried about your eating behaviours, then please talk to your GP. For advice on healthy eating, please see the Weight Concern website: www.weightconcern.org.uk

If you have any further questions about the study, please do not hesitate to send an email to Claudia Hunot: c.hunot.12@ucl.ac.uk.

Adult Eating Behaviour Questionnaire (AEBQ)

15.

Thank you for taking the time to complete our questionnaire.

END OF SURVEY.

Appendix 5.6 Illustrative example of themes obtained from adult piloting (Study 2, Chapter 5)

Regarding response option: 'never', 'rarely', 'sometimes', 'often' and 'always'.

"response options do not always fit the question" (n=1)

"phrasing with the scale is ambiguous and I could not provide meaningful answers as a result" (n=1)

"Some of the questions don't really work with the answers given" (n=1)

"The 'I often feel' questions seem strange given that the response options are frequency based" (n=1)

"I think the response options would make more sense if they were agree to disagree rather than never to always" (n=1)

"Maybe one needs to differentiate questions between frequency (appropriate for some questions), and a True/False scale (appropriate for others)" (n=1)

Regarding item: Given the choice, I would always have food in my mouth

"sounds a bit odd"(n=4)

"over the top" (n=1)

"the questions 'given the choice I would always be eating/have food in my mouth' implies there is a barrier to eating" (n=1)

Regarding item: I am interested about food

"the question [I am interested about food] sound a bit strange, it is weird" (n=3).

Appendix 5.7 Adult Eating Behaviour Questionnaire (47-items) (Study 2, Sample 1)**Adult Eating Behaviour Questionnaire**

1.

Thank you for your interest in our research. The aim of this research is to validate a questionnaire that can be used to identify adult's eating behaviours. In total the survey will take about 10 minutes of your time to complete. We understand that some of the questions are a little repetitive, but we are using this process to filter out questions that will be eliminated.

All responses to this questionnaire are anonymous, so we won't be able to respond directly to any answers. If you are worried about your eating behaviours, then please talk to your GP. For advice on healthy eating, please see the Weight Concern website: www.weightconcern.org.uk

If you have any further questions about the study, please do not hesitate to send an email to Claudia Hunot: c.hunot.12@ud.ac.uk.

If you are happy to take part, please click on 'Next' below. By clicking on "Next" you are agreeing that:

- You have read the notes written above and you understand what the survey involves.
- You understand that as your participation is anonymous it will not be possible for us to withdraw your responses once you have completed the survey.
- The project has been explained to you and that you agree to take part in the survey.

Adult Eating Behaviour Questionnaire

2.

* 1. What age group are you in?

- 20 - 24 years old
- 25 - 29 years old
- 30 - 39 years old
- 40 - 49 years old
- 50 - 59 years old
- 60+ years old

Adult Eating Behaviour Questionnaire

3.

* 2. Are you

- Male
- Female

Adult Eating Behaviour Questionnaire

4.

* 3. What best describes your ethnic origin?

- | | |
|--|---|
| <input type="radio"/> White British | <input type="radio"/> Other Asian background |
| <input type="radio"/> White Irish | <input type="radio"/> Mixed White and Black Caribbean |
| <input type="radio"/> Other White background | <input type="radio"/> Mixed White and Black African |
| <input type="radio"/> Black or Black British African | <input type="radio"/> Mixed White and Asian |
| <input type="radio"/> Black or Black British Caribbean | <input type="radio"/> Mixed Black and Asian |
| <input type="radio"/> Other Black background | <input type="radio"/> Other Mixed background |
| <input type="radio"/> Asian or Asian British Indian | <input type="radio"/> Chinese |
| <input type="radio"/> Asian or Asian British Pakistani | <input type="radio"/> Other Chinese background |
| <input type="radio"/> Asian or Asian British Bangladeshi | <input type="radio"/> Prefer not to answer |
| <input type="radio"/> Other (please specify) | |

Adult Eating Behaviour Questionnaire

5.

* 4. What is your current weight approximately? Please state in kilograms OR stones AND pounds .

Kilograms

OR Stones

Pounds

Adult Eating Behaviour Questionnaire

6.

* 5. What is your current height approximately? Please state in centimeters OR feet AND inches .

Centimetres

OR Feet

Inches

Adult Eating Behaviour Questionnaire

7.

* 6. How would you describe your current weight? (tick one only)

- Very underweight
- Underweight
- About the right weight
- Somewhat overweight
- Very overweight
- Obese

Adult Eating Behaviour Questionnaire

8. Copy of page:

7. How old are you?

Years

Adult Eating Behaviour Questionnaire

9.

* 8. What is the highest level of education you have obtained? Tick one

- Finished school at or before the age of 15
- Completed GCSE's, O-levels or equivalent
- Completed A-levels or equivalent
- Completed further education but not a degree
- Completed a undergraduate degree
- Completed a postgraduate degree
- Other (please specify)

Adult Eating Behaviour Questionnaire

10.

* 9. Does your household own a car or van? (tick one only)

- No
- Yes, one
- Yes, more than one

Adult Eating Behaviour Questionnaire

11.

* 10. Are you currently (tick the one that currently takes up most of your time)

- Employed full-time
- Employed part-time
- Unemployed
- Self-employed
- Full-time homemaker
- Unpaid/Voluntary work
- Student
- Disabled or too ill to work
- Retired

Adult Eating Behaviour Questionnaire

12.

* 11. Please select the option which best describes your current living arrangement (main residence)

- Own outright
- Own with mortgage
- Rent from local authority/housing association
- Rent privately
- Squatting
- Living with family
- Living in University/College halls

Adult Eating Behaviour Questionnaire

13.

* 12. Please tick the income bracket which best describes your household income (include any benefits or other sources of income you may receive) (tick one only)

- Less than £9,999 per year
- £10,000-£19,999 per year
- £20,000-£29,999 per year
- £30,000-£39,999 per year
- £40,000-£49,999 per year
- £50,000-£59,999 per year
- £60,000 or more per year
- I am currently not earning any money
- Do not wish to answer

Adult Eating Behaviour Questionnaire

14.

* 13. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
I love food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often decide that I don't like a food, before tasting it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I look forward to mealtimes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I refuse new foods at first	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire

15.

* 14. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
If I miss a meal I get irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often leave food on my plate at the end of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I am tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy tasting new foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel hungry when I am with someone who is eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm bored	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire

16.

* 15. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
I often finish my meals quickly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Even if I am full up I find room to eat my favourite food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am difficult to please with meals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Given the choice, I would eat most of the time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am interested in tasting food I haven't tasted before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire

17.

* 16. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
I eat less when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I allowed myself, I would eat too much	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often notice my stomach rumbling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm bored	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always thinking about food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often get full before my meal is finished	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire

18.

* 17. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
I eat less when I have nothing else to do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy a wide variety of foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am often last at finishing a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more and more slowly during the course of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel so hungry that I have to eat something right away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I am happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat slowly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adult Eating Behaviour Questionnaire

19.

* 18. Please read the following statements and tick the boxes most appropriate to your eating behaviour.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly agree
I cannot eat a meal if I have had a snack just before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get full up easily	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel hungry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a big appetite	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see or smell food that I like, it makes me want to eat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat more when I have nothing else to do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If my meals are delayed I get light-headed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I eat less when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 5.8 Ethical Approval, Study 2, Chapter 5

UCL RESEARCH ETHICS COMMITTEE
GRADUATE SCHOOL OFFICE



Professor Jane Wardle
Department of Epidemiology and Public Health
1-19 Torrington Place
UCL

29 January 2013

Dear Professor Wardle

Notification of Ethical Approval

Project ID: 4378/001: Validation of the Adolescent Eating Behaviour Questionnaire

I am pleased to confirm that your study has been approved by the UCL Research Ethics Committee for the duration of the project i.e. until January 2014.

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: <http://www.grad.ucl.ac.uk/ethics/> and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events

For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events

The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

With best wishes for the research.

Yours sincerely

Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc: Claudia Hunot & Dr Rebecca Beeken

UCL Research Ethics Committee, c/o The Graduate School, North Cloisters, Wilkins Building
University College London Gower Street London WC1E 6BT
Tel: +44 (0)20 7679 7844 Fax: +44 (0)20 7679 7043
ethics@ucl.ac.uk
www.ucl.ac.uk/gradschool

Appendix 5.9 AEBQ items compared to the original CEBQ items

AEBQ	Item source	AEBQ item	CEBQ item
H	New	I often feel so hungry that I have to eat something right away	
	New	I often notice my stomach rumbling	
	New	If I miss a meal I get irritable	
	New	If my meals are delayed I get light-headed	
	New	I often feel hungry	
FR	New	I often feel hungry when I am with someone who is eating	
	New	I am always thinking about food	
	New	When I see or smell food that I like, it makes me want to eat	
	CEBQ (FR)	Given the choice, I would eat most of the time	Given the choice, my child would eat most of the time
	NI	-	Even if my child is full up s/he finds room to eat his/her favourite food
	NI	-	If given the chance, my child would always have food in his/her mouth
	NI	-	My child is always asking for food
EOE	NI	-	If allowed to, my child would eat too much
	CEBQ (EOE)	I eat more when I'm annoyed	My child eats more when annoyed
	CEBQ (EOE)	I eat more when I'm worried	My child eats more when worried
	New	I eat more when I'm upset	NI
	CEBQ (EOE)	I eat more when I'm anxious	My child eats more when anxious
	New	I eat more when I'm angry	NI
	NI	-	My child eats more when s/he has nothing else to do
EF	CEBQ (EF)	I love food	My child loves food
	CEBQ (EF)	I look forward to mealtimes	My child looks forward to mealtimes
	CEBQ (EF)	I enjoy eating	My child enjoys eating
	NI	-	My child is interested in food
SR	CEBQ (SR)	I often leave food on my plate at the end of a meal	My child leaves food on his/her plate at the end of a meal
	CEBQ (SR)	I often get full before my meal is finished	My child gets full before his/her meal is finished
	CEBQ (SR)	I get full up easily	My child gets full up easily
	CEBQ (SR)	I cannot eat a meal if I have had a snack just before	My child cannot eat a meal if s/he has had a snack just before
	NI	-	My child has a big appetite*

AEBQ	Item source	AEBQ item	CEBQ item
EUE	New	I eat less when I'm worried	
	CEBQ (EUE)	I eat less when I'm angry	My child eats less when angry
	CEBQ (EUE)	I eat less when I'm upset	My child eats less when upset
	New	I eat less when I'm annoyed	
	New	I eat less when I'm anxious	
	NI	-	My child eats more when she is happy
	NI	-	My child eats less when s/he is tired
FF	CEBQ (FF)	I refuse new foods at first	My child refuses new foods at first
	NI	-	My child is difficult to please with meals
	CEBQ (FF)	I often decide that I don't like a food, before tasting it	My child decides that s/he doesn't like a food, even without tasting it
	CEBQ (FF)	I enjoy tasting new foods*	My child enjoys tasting new foods*
	CEBQ (FF)	I am interested in tasting food I haven't tasted before*	My child is interested in tasting food s/he hasn't tasted before*
	CEBQ (FF)	I enjoy a wide variety of foods*	My child enjoys a wide variety of foods*
SE	CEBQ (SE)	I eat slowly	My child eats slowly
	CEBQ (SE)	I am often last at finishing a meal	My child takes more than 30 minutes to finish a meal
	CEBQ (SE)	I eat more and more slowly during the course of a meal	My child eats more and more slowly during the course of a meal
	CEBQ (SE)	I often finish my meal (s) quickly*	My child finishes his/her meal quickly*

H, 'hunger'; FR, 'food responsiveness'; EOE, 'emotional over-eating'; EF, 'enjoyment of food'; SR, 'satiety responsiveness'; EUE, 'emotional under-eating'; FF, 'food fussiness'; SE, 'slowness in eating'.

Appendix 5.10 Adult Eating Behaviour Questionnaire with scoring system

Adult Eating Behaviour Questionnaire					
Please read each statement and tick the box most appropriate to you					
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I love food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often decide that I don't like a food, before tasting it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I look forward to mealtimes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more when I'm annoyed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often notice my stomach rumbling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I refuse new foods at first	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more when I'm worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If I miss a meal I get irritable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more when I'm upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often leave food on my plate at the end of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy tasting new foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often feel hungry when I am with someone who is eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often finish my meals quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat less when I'm worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more when I'm anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Given the choice, I would eat most of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I eat less when I'm angry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am interested in tasting new food I haven't tasted before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat less when I'm upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more when I'm angry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am always thinking about food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often get full before my meal is finished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy a wide variety of foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am often last at finishing a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat more and more slowly during the course of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat less when I'm annoyed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often feel so hungry that I have to eat something right away	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat slowly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I cannot eat a meal if I have had a snack just before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I get full up easily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often feel hungry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When I see or smell food that I like, it makes me want to eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If my meals are delayed I get light-headed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I eat less when I'm anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Adult Eating Behaviour Questionnaire - Scoring information

		Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
EF	I love food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FF	I often decide that I don't like a food, before tasting it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EF	I enjoy eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EF	I look forward to mealtimes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EOE	I eat more when I'm annoyed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H	I often notice my stomach rumbling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FF	I refuse new foods at first	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EOE	I eat more when I'm worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H	If I miss a meal I get irritable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EOE	I eat more when I'm upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SR	I often leave food on my plate at the end of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FF*	I enjoy tasting new foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FR	I often feel hungry when I am with someone who is eating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SE*	I often finish my meals quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EUE	I eat less when I'm worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EOE	I eat more when I'm anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FR	Given the choice, I would eat most of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EUE	I eat less when I'm angry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FF*	I am interested in tasting new food I haven't tasted before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EUE	I eat less when I'm upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EOE	I eat more when I'm angry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FR	I am always thinking about food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SR	I often get full before my meal is finished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FF*	I enjoy a wide variety of foods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SE	I am often last at finishing a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SE	I eat more and more slowly during the course of a meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
EUE	I eat less when I'm annoyed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H	I often feel so hungry that I have to eat something right away	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SE	I eat slowly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SR	I cannot eat a meal if I have had a snack just before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SR	I get full up easily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H	I often feel hungry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FR	When I see or smell food that I like, it makes me want to eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H	If my meals are delayed I get light-headed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EUE	I eat less when I'm anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Reversed items

Enjoyment of food = item mean EF
 Emotional over-eating = item mean EOE
 Emotional under-eating = item mean EUE
 Food fussiness = item mean FF
 Food responsiveness = item mean FR
 Slowness in eating = item mean SE
 Hunger = item mean H
 Satiety responsiveness = item mean SR

Strongly disagree =1, Disagree = 2, Neither agree nor disagree = 3, Agree =4, Strongly agree =5

Appendix 6.1 Relevant parts of the Self-Regulation of Eating Behaviour Questionnaire which contained the Adult Eating Behaviour Questionnaire items (Study 3, Sample 2)

Self-Regulation of Eating Behaviour Questionnaire

Thank you for your interest in our research.

The aim of this research is to design a questionnaire to assess 'self-regulation of eating behaviour' (how easy people find it to control and manage their eating). In total the survey should only take 25 minutes of your time.

All responses to this questionnaire are confidential and your responses will not be linked to any identifying information.

This study has been approved by the UCL Research Ethics Committee [5766/002].

If you have any further questions about the study, please do not hesitate to send an email to Nathalie Kliemann:
nathalie.kliemann.13@ucl.ac.uk

If you are happy to take part, please click on 'Next' below. By clicking on "Next" you are agreeing that:

- You have read the notes written above and you understand what the survey involves.
- You understand that as your participation is anonymous it will not be possible for us to withdraw your responses once you have completed the survey.

Self-Regulation of Eating Behaviour Questionnaire					
*22. Please indicate the extent to which you agree that the following items describe you.					
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1. I love food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I often decide that I don't like a food, before tasting it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I enjoy eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I eat more when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I look forward to mealtimes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I refuse new foods at first	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I eat more when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. If I miss a meal I get irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I eat more when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I often leave food on my plate at the end of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I enjoy tasting new foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I often feel hungry when I am with someone who is eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Self-Regulation of Eating Behaviour Questionnaire

***23. Please indicate the extent to which you agree that the following items describe you.**

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
13. I often finish my meals quickly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I eat less when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I eat more when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Given the choice, I would eat most of the time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I eat less when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I am interested in tasting food I haven't tasted before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I eat less when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I often notice my stomach rumbling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I eat more when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I am always thinking about food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. I often get full before my meal is finished	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. I enjoy a wide variety of foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Self-Regulation of Eating Behaviour Questionnaire					
*24. Please indicate the extent to which you agree that the following items describe you.					
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
25. I am often last at finishing a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. I eat more and more slowly during the course of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. I eat less when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. I often feel so hungry that I have to eat something right away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. I eat slowly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. I cannot eat a meal if I have had a snack just before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31. I get full up easily	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32. I often feel hungry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33. When I see or smell food that I like, it makes me want to eat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34. If my meals are delayed I get light-headed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35. I eat less when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

***25. What is your current weight approximately? Please give this in stones and pounds or kilograms.**

Kilograms

OR Stones and pounds

OR Pounds

***26. What is your height approximately? Please give this in feet and inches or centimetres.**

Centimetres

OR Feet and Inches

OR Inches

Self-Regulation of Eating Behaviour Questionnaire

***32. Would you be interested in receiving feedback on your appetitive traits (i.e. styles of eating that could make you gain or lose weight) and tips on how to manage them accordingly?**

- Yes
 No
 Maybe

If no or maybe, please give your reason:

***33. What format would you like to receive this information in?**

- In person
 Via email
 Via phone
 On-line

Other (please specify)

***34. Do you think that knowing about your appetitive traits would change how you eat?**

- Yes
 No
 Maybe

If maybe, please give your reason:

***35. Would you be interested in taking part in a study looking at the effect of giving people feedback on their appetitive traits?**

- Very likely to take part
 Likely to take part
 Somewhat likely to take part
 Probably would not take part

Self-Regulation of Eating Behaviour Questionnaire

***36. If the study on appetitive trait feedback took place over eight weeks, how often would you be interested in receiving input/tips as feedback?**

Daily
 Weekly
 Fortnightly
 Monthly
 Never

***37. Is there any information you think would be particularly useful for a study on appetitive trait feedback? (choose as many options as you like)**

Tips on becoming aware of how hungry you are
 Healthy food options
 Tips on how to like healthy foods more
 Tips for managing emotional eating
 Tips on how controlling how much you eat when around tempting food
 Tips on resisting eating
 Tips on eating self-awareness (do you know when you are hungry, do you over-eat or under-eat)

***38. Are these illnesses influenced by diet?**

	Yes	No	I don't know
Heart disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cancer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stroke	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dementia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High blood pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broken bones	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diabetes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Self-Regulation of Eating Behaviour Questionnaire

***39. How important are the following for a healthy diet?**

	Yes	No	I don't know
Eat plenty of fruit and vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Choose organic foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat wholegrain foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat less red meat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use lower fat milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat fewer carbohydrates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Choose fresh rather than frozen vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avoid coffee and caffeine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat less fried foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat less sugary foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

***40. How important are the following for a healthy diet?**

	Yes	No	I don't know
Eat less processed meat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vitamin supplements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avoid food additives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat breakfast everyday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat less salt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat less saturated fat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat a high fibre diet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat more trans-fat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drink more water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eat more protein	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>		

***41. Are you...**

Male

Female

***42. How old are you?**

Self-Regulation of Eating Behaviour Questionnaire***43. Are you...**

- Single
 Married
 Living as married
 Separated
 Divorced
 Widowed

44. What is the first part of your postcode?**45. What age group are you in?**

- 18-29 years old
 30-39 years old
 40-49 years old
 50-59 years old
 60+ years old

***46. What best describes your ethnic origin?**

- White
 Black
 Asian
 Mixed
 Other

Other (please specify)

Self-Regulation of Eating Behaviour Questionnaire***47. What is the highest level of education you have completed or are doing now?**

- Primary school
- Secondary school
- O level/ GCSEs
- A levels
- Technical or trade certificate
- Diploma
- Degree
- Post-graduate degree

***48. What is your current employment situation? (tick one that currently takes most of your time)**


- Employed full-time
- Employed part-time
- Unemployed
- Self-employed
- Full-time homemaker
- Unpaid/Voluntary work
- Student
- Disabled or too ill to work
- Retired

***49. Please select the option which best describes your current living arrangement (main residence).**

- Own your home outright
- Own your home with mortgage
- Rent from local authority/housing association
- Rent privately
- Living with parents
- Living in University/College halls

Thank you very much for taking part in this survey – your views are extremely important to us and help to shape the future of research. If you have any questions you can email Nathalie Kliemann at nathalie.kliemann.13@ucl.ac.uk or Claudia Hunot at c.hunot.12@ucl.ac.uk

Appendix 6.2 Ethical approval, Study 3, Chapter 6

<p>UCL RESEARCH ETHICS COMMITTEE ACADEMIC SERVICES</p> 
<p>Professor Jane Wardle HBRC Department of Epidemiology and Public Health UCL</p> <p>23 October 2014</p> <p>Dear Professor Wardle</p> <p><u>Notification of Ethical Approval</u> <u>Project ID 5766/002: Development and validation of the self-regulation of eating behaviour questionnaire</u></p> <p>In my capacity as Chair of the UCL Research Ethics Committee (REC) I am pleased to confirm that I have approved your study for the duration of the project i.e. until December 2015.</p> <p>Approval is subject to the following conditions:</p> <ol style="list-style-type: none"> 1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form': http://ethics.grad.ucl.ac.uk/responsibilities.php 2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported. <p><u>Reporting Non-Serious Adverse Events</u> For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.</p> <p><u>Reporting Serious Adverse Events</u> The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.</p> <p>On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.</p>

With best wishes for the research.

Yours sincerely



Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc:
Nathalie Kliemann, Claudia Hunot, Fiona Johnson & Helen Croker, Applicant
Professor Andrew Steptoe

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Appendix 7.1 Feasibility questions obtained from an on-line panel who completed the AEBQ (n=711)^a (Sample 2)

Feasibility questions regarding the interest of participants in participating in an intervention involving feedback on their AEBQ responses and receiving tailored appetitive trait feedback	Frequency n (%)
Would you be interested in receiving feedback on your appetitive traits (i.e. styles of eating that could make you gain or lose weight) and tips on how to manage them accordingly?	n=954 ^b
Yes	558 (58.5%)
No	243 (25.5%)
Maybe	153 (16.0%)
What format would you like to receive this information in?	
In person	15 (2.1%)
Via e-mail	611 (85.9%)
Via phone	8 (1.1%)
On-line	77 (10.8%)
Do you think that knowing about your appetitive traits would change how you eat?	
Yes	362 (50.9%)
No	45 (6.3%)
Maybe	304 (42.8%)
Would you be interested in taking part in a study looking at the effect of giving people feedback on their appetitive traits?	
Very likely to take part	254 (35.7%)
Likely to take part	186 (26.2%)
Somewhat likely to take part	185 (26.0%)
Probably would not take part	86 (12.1%)
If the study on appetitive trait feedback took place over eight weeks, how often would you be interested in receiving input/tips as feedback?	
Daily	111 (15.6%)
Weekly	451 (63.4%)
Fortnightly	65 (6.8%)
Monthly	50 (5.2%)
Never	34 (4.8%)
Is there any information you think would be particularly useful? (Choose as many options as you like)	
Tips on becoming aware of how hungry you are	273/681 (28.6%)
Healthy food options	444/628 (46.5%)
Tips on how to like healthy foods more	295/659 (30.9%)
Tips for managing emotional eating	283/671 (29.7%)
Tips on how to control how much you eat when around tempting food	362/592 (37.9%)
Tips on resisting eating	326/628 (34.2%)
Tips on eating self-awareness (do you know when you are hungry?)	373/581 (39.1%)

^a Data was analysed only for those participants who replied they 'yes' or 'maybe' would be interested in participating in an intervention involving feedback on their AEBQ responses and receiving tailored appetitive trait feedback (i.e. n=711).

^bInitial total data collected n=954.

Appendix 7.2 Individualised appetitive trait tip feedback for high 'food responsiveness' and high 'emotional over-eating', low 'satiety responsiveness' and fast eating (low 'slowness in eating')

Tips to curb your appetite



Could losing weight improve my health?

If you are overweight, losing just a small amount of weight (e.g. 3-5% of your current body weight) could improve your health through lowering blood pressure, and reducing the risk of overweight-related conditions such as diabetes, heart disease or cancer.



What are appetitive traits and how can they help?

Some people find it harder than others to lose weight. One of the ways in which people differ is in how they respond to food; these are known as 'appetitive traits'. For example, some people have an urge to eat when they smell, see, or talk about food - this is called 'food responsiveness'. Some people are insensitive to feelings of fullness and carry on eating without noticing they have had enough - this is known as poor 'satiety responsiveness'. Research has shown that these appetitive traits can mean a person is more likely to gain weight and will find it harder to lose weight. These traits are likely to be partly influenced by genes, but it is possible to learn to react differently. **Knowing which traits you have, and understanding how best to manage them, may help you with weight control.**

Your personal appetite profile

You recently filled in a questionnaire designed to measure your appetitive traits. The good news is you can now follow your own personalised tips.

The **appetitive traits** that could be making things more difficult for you are....

- You **respond highly to food**.
- You are an **emotional eater**.
- You have low '**satiety responsiveness**'.
- You are a **fast eater**.

These are your tips!

➤ Having high levels of 'food responsiveness' means that the sight or smell of food, or even looking at someone else eating, can make you want to eat



- Some people are particularly susceptible to food temptations around them. Avoid buying unhealthy foods and don't have them available in your home. This will help to take away the urge to eat them.
- Try to identify what specific types of food make you want to eat. So if you walk past a bakery or a particular shop that sells treats you love on your way home, take a different route.
- If you are with others who are eating and it is not your meal time, try having a low calorie drink such as water with lime/orange, tea or coffee.
- Suggest doing things with friends that don't involve food, like going for a walk in the park.
- Avoid going to the supermarket when you are hungry and use a shopping list. This will help stop you from buying foods you don't need.



- Some people can train themselves to resist their '**problem foods**'. You could try this. Start with something easy. If you like salty foods, use a plain cracker, if you like sweet foods, use a plain biscuit. Wrap it up in cling film and leave it by your desk (or somewhere where you see it often). See how you feel about this.
- Repeat for 10 days, and see if your urge to eat it goes down. Then move to a more desirable cracker or biscuit. Once you've done this for several days and have successfully avoided eating the food, repeat the exercise with food on a plate. Remember, sit it out and avoid the temptation to eat. This will help you train yourself to be less responsive to food.

These are your tips!

➤ You are an **emotional eater** you tend to eat to comfort yourself when you feel sad, or worried.

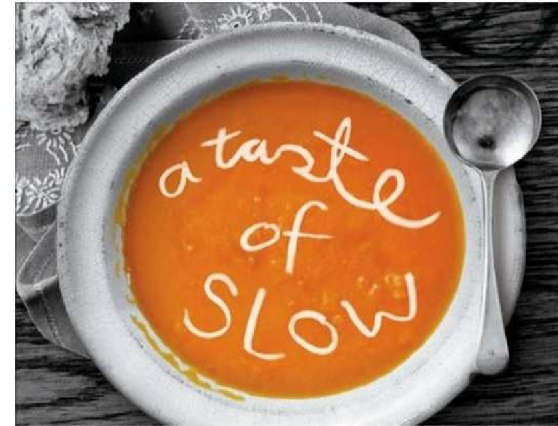
- A lot of people find food comforting. When you are feeling upset, annoyed or anxious this may be a risky time. Eating something when you are feeling this way may make you feel better in the short term, but in the long run might make you feel worse, especially if you are trying to manage your weight.
- Have a plan for another way to comfort yourself that does not involve food. Identify three alternatives to eating that might help you distract yourself and that you enjoy doing or that feel like a treat. Talk to a friend about how you feel, play a game, go on social media, read the news, go for a walk.



These are your tips!

➤ You have low 'satiety responsiveness' you are less likely to notice when you are full and you may eat more than you need.

- Some people overeat because they have trouble recognising when they are full. Half way through your meal, stop and try to pay attention to how full you are.
- Serve yourself a meal that is the right amount for you. Don't have second helpings. Put left overs in the fridge or freezer straight away. If you need help with portion sizes, go to : <http://www.nhs.uk/Livewell/5ADAY/Pages/Portionsizes.aspx>
- You may be used to eating more than you need. Retrain yourself. It takes time to get used to eating smaller quantities of food and feeling satisfied. Try using a smaller plate than usual.
- If someone else is serving- remember you do not have to clear your plate. Leftovers can be thrown away or put away to save for the next day.
- Avoid 'mindless' eating. Don't eat while you're watching the television, writing an email, or reading. Stop eating if you are doing something else. Try to eat in a designated place and at set times.



These are your tips!

➤ You are a **fast eater**, you tend not to notice when you are full, which can make you over-eat.

- Eating slowly gives your brain the time to realise that food has entered your body and energy supply is on its way. This will help you feel full. Try to eat slower than those that are eating around you, and try to be the last one to finish your meal.
- Put your fork/spoon down in between bites. Take the time to enjoy the taste and the texture of the foods you eat.
- Always sit down to eat your meals if you can. Standing up or rushing from one place to the next tends to increase speed of eating.



Set some goals around your tips and monitor them:



Set yourself weekly goals. Include the date you set your goal and review your goal one week later. Write in your outcome score using one of the following emojis:

😊 = achieved 😊 = still trying 😞 = not managed to work on this yet

My goal this week is:

Today's date:

Review date:

Outcome score:

I will take the following steps to achieve my goal:

I have thought about and/or planned for the following:

- Things that could get in my way and how I can overcome them
- People who might be able to help
- Time I'm going to give it
- How and when I am going to review my goal
- How I will reward myself when I succeed (with something other than food, e.g. take time to yourself, read a magazine, buy a voucher from your favourite store and save it for a bigger purchase later). Write down ideas for rewards you might like

Appendix 7.3 Individualised appetitive trait tip feedback for high 'food responsiveness', low 'satiety responsiveness' and fast eating (low 'slowness in eating')

Tips to curb your appetite



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If you are overweight, losing just a small amount of weight (e.g. 3-5% of your current body weight) could improve your health through lowering blood pressure, and reducing the risk of overweight-related conditions such as diabetes, heart disease or cancer.



What are appetitive traits and how can they help?

Some people find it harder than others to lose weight. One of the ways in which people differ is in how they respond to food; their **'appetitive traits'**. For example, some people have an urge to eat when they smell, see, or talk about food - this is called 'food responsiveness'. Some people are insensitive to feelings of fullness and carry on eating without noticing they have had enough - this is known as poor 'satiety responsiveness'. Others find they are hungry all the time. Research has shown that these appetitive traits can mean a person is more likely to gain weight and will find it harder to lose weight. These traits are likely to be partly influenced by genes, but it is possible to learn to react differently. **Knowing which traits you have, and understanding how best to manage them, may help you with weight control.**

Your personal appetite profile

You recently filled in a questionnaire designed to measure your appetitive traits. The good news is you

- ✓ don't use food to help you cope with your emotions - you don't comfort eat..

The **appetitive traits** that could be making things more difficult for you are....

- You **respond highly to food**.
- You have low **'satiety responsiveness'**.
- You are a **fast eater**.

These are your tips!

➤ Having high levels of 'food responsiveness' means that the sight or smell of food, or even looking at someone else eating, can make you want to eat



- Some people are particularly susceptible to food temptations around them. Avoid buying unhealthy foods and don't have them available in your home. This will help to take away the urge to eat them.
- Try to identify what specific types of food make you want to eat. So if you walk past a bakery or a particular shop that sells treats you love on your way home, take a different route.
- If you are with others who are eating and it is not your meal time, try having a low calorie drink such as water with lime/orange, tea or coffee.
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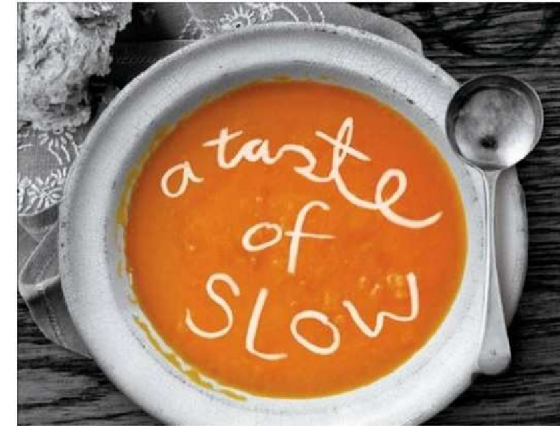


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These are your tips!

➤ You have low 'satiety responsiveness' you are less likely to notice when you are full and you may eat more than you need.

- Some people overeat because they have trouble recognising when they are full. Half way through your meal, stop and try to pay attention to how full you are.
- Serve yourself a meal that is the right amount for you. Don't have second helpings. Put left overs in the fridge or freezer straight away. If you need help with portion sizes, go to : <http://www.nhs.uk/Livewell/5ADAY/Pages/Portionsizes.aspx>
- You may be used to eating more than you need. Retrain yourself. It takes time to get used to eating smaller quantities of food and feeling satisfied. Try using a smaller plate than usual.
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Set some goals around your tips and monitor them:



Set yourself weekly goals. Include the date you set your goal and review your goal one week later. Write in your outcome score using one of the following emojis:

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- Time I'm going to give it
- How and when I am going to review my goal
- How I will reward myself when I succeed (with something other than food, e.g. take time to yourself, read a magazine, buy a voucher from your favourite store and save it for a bigger purchase later). Write down ideas for rewards you might like

Appendix 7.4. Initial Survey Monkey questionnaire sent to members of the 'Big Panel' in Study 4, Chapter 7**Questionnaire on appetitive traits and food preferences**

Thank you for your interest in this study. The aim of the research is to investigate:

- 1) Differences in appetite and eating styles, such as whether people eat more when food is around or eat even when they are not hungry
- 2) Food preferences
- 3) Weight management practices

This study has been approved by the UCL Research Ethics Committee – Project ID number 4378/003.

In total the survey will take about 20 minutes of your time. It is important that you take the time to answer the questionnaire carefully. Your input is very valuable to us, so please ensure that you allow yourself the time to do this.

In a section of the questionnaire there is an option to provide your email. If you do not provide your email address you understand that your participation will be anonymous and it will not be possible for us to withdraw your responses once you have completed the survey. It is up to you to decide whether to take part or not; choosing not to take part will not disadvantage you in any way. If you do decide to take part, you are still free to withdraw at any time and without giving a reason.

For more advice on healthy eating, please see the Weight Concern website:
www.weightconcern.org.uk

For more information about the study, please contact Claudia Hunot c.hunot.12@ucl.ac.uk or Andrea Smith andrea.smith.14@ucl.ac.uk.

If you are happy to take part in this study, please click on 'Next' below. By clicking on "Next" you are agreeing and consenting that:

- You have read the notes written above and you understand what the survey involves.
- You understand that as your participation is anonymous it will not be possible for us to withdraw your responses once you have completed the survey.

Questionnaire on appetitive traits and food preferences

Please complete the following information:

Questionnaire on appetitive traits and food preferences

* 1. Are you?

- Male
- Female

* 2. How old are you?

Age

* 3. What is the first part of your postcode?

* 4. Are you?

- Single
- Married
- Living with partner
- Seperated
- Divorced
- Widowed

Questionnaire on appetitive traits and food preferences

* 5. What best describes your ethnic origin?

- White
- Black
- Asian
- Mixed

Other (please specify)

* 6. What is the highest level of education you have completed or are doing now?

- Primary school
- Secondary school
- O level/GCSE
- A levels
- Technical or trade certificate
- Diploma
- Undergraduate degree
- Post-graduate degree

* 7. What is your current employment status? (tick one that currently takes most of your time)

- Employed full-time
- Employed part-time
- Unemployed
- Self-employed
- Full-time homemaker
- Unpaid voluntary work
- Student
- Disabled or too ill to work
- Retired

* 8. Please select the option which best describes your current living arrangement (main residence)

- Own your home outright
- Own your home with mortgage
- Rent from local authority/housing association
- Rent privately
- Living with parents
- Living in University/College residential accommodation

Questionnaire on appetitive traits and food preferences

* 9. What is your current weight approximately? Please give this in:

Stones and pounds (e.g.
10st 5lb)

OR Pounds (e.g. 145lb)

OR Kilograms (e.g.
65.8kg)

* 10. What is your height approximately? Please give this in:

Feet and inches (e.g. 5ft
9in)

OR Inches (e.g. 68.9in)

OR Centimetres (e.g.
175cm)

Questionnaire on appetitive traits and food preferences

* 11. How would you describe your current weight?

- Very underweight
- Underweight
- About the right weight
- Somewhat overweight
- Very overweight
- Obese

Questionnaire on appetitive traits and food preferences

* 12. Please read each statement and tick the box most appropriate to you. Tick a box in every row

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1. I love food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I often decide that I don't like a food, before tasting it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I enjoy eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I look forward to mealtimes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I eat more when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I often notice my stomach rumbling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I refuse new foods at first	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I eat more when I'm worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questionnaire on appetitive traits and food preferences

* 13. Please read each statement and tick the box most appropriate to you. Tick a box in every row

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
9. If I miss a meal I get irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I eat more when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I often leave food on my plate at the end of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I enjoy tasting new foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I often feel hungry when I am with someone who is eating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I often finish my meals quickly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I eat less when I am worried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. I eat more when I am anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questionnaire on appetitive traits and food preferences

* 14. Please read each statement and tick the box most appropriate to you. Tick a box in every row

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
17. Given the choice, I would eat most of the time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I eat less when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I am interested in tasting new food I haven't tasted before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I eat less when I'm upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I eat more when I'm angry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I am always thinking about food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. I often get full before my meal is finished	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. I enjoy a wide variety of foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. I am often last at finishing a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. I eat more and more slowly during the course of a meal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questionnaire on appetitive traits and food preferences

* 15. Please read each statement and tick the box most appropriate to you. Tick a box in every row

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
27. I eat less when I'm annoyed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. I often feel so hungry that I have to eat something right away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. I eat slowly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. I cannot eat a meal if I have had a snack just before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31. I get full up easily	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32. I often feel hungry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33. When I see or smell food that I like, it makes me want to eat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34. If my meals are delayed I get light-headed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35. I eat less when I'm anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questionnaire on appetitive traits and food preferences

* 16. Would you be interested in receiving feedback on your eating behavior and appetite (i.e. styles of eating that could make you gain or lose weight) and tips on how to manage them?

- Yes
- No

17. Giving people who want to manage their weight feedback about their appetite, along with simple strategies and tips, may help them to be more successful. We are planning a study to test this.

If you are interested in taking part in this study, please provide your email address so we can contact you directly with further information. If you have any further queries about the study, please contact Claudia Hunot: c.hunot.12@ucl.ac.uk

Contact email:

Questionnaire on appetitive traits and food preferences

Appendix 7.5 Survey Monkey questionnaire sent to potential 'Big Panel' members after a previous first contact, to assess inclusion criteria for participation in Study 4, Chapter 7

Appetitive trait weight management tips

1. Thank you for your interest in this study

The reason we are contacting you, is because a few weeks ago you completed a questionnaire on differences in appetite and eating styles, such as whether people eat more when food is around or eat even when they are not hungry. You provided us with your contact details because you were interested in receiving feedback on your eating behaviour and appetite (i.e. styles of eating that could make you gain or lose weight) and tips on how to manage them.

We are now contacting you to see if you would still be interested in participating in this study. We will explain in greater detail what the study will consist of and we would need you to fill in just a few more questions, which will help us assess if you will be able to participate.

In total these questions will take about 5-8 minutes of your time. It is important that you take the time to answer the questionnaire carefully. Your input is very valuable to us, so please ensure that you allow yourself the time to do this.

For more advice on healthy eating, please see the Weight Concern website: www.weightconcern.org.uk

For more information about the study, please contact Claudia Hunot: c.hunot.12@ucl.ac.uk

If you are happy to take part in this study, please click on 'Next' below. By clicking on "Next" you are agreeing and consenting that:

- You have read the notes written above and you understand what the survey involves.

Appetitive trait weight management tips

2. Information sheet about a brief appetitive trait feedback intervention study

We would like to invite you to participate in a research project, which is being carried out by researchers from University College London (UCL). This study has been approved by the UCL Research Ethics Committee Project ID Number: 4378/003.

Before you decide whether you want to take part, it is important for you to read the following information carefully and discuss it with others if you wish. Please ask us if there is anything that is not clear to you.

Appetitive trait weight management tips

3. What is the purpose of the study?

The aim of the study is to tailor weight management tips based on a person's appetitive trait scores. Appetitive traits are styles of eating such as eating more when food is around or eating even when you are not hungry. We think that giving people who want to manage their weight some feedback about their appetitive traits along with some simple strategies/tips, might help them to be more successful. So we are thinking about doing a study to test this out.

Appetitive trait weight management tips

4. What will be involved if I agree to take part in this study?

If you decide to participate, you will first have to sign a consent form (which we will send you once we begin the study in the next few weeks). Once you have done this we will contact you and return to you your appetitive trait scores, from the questionnaire you previously answered. According to your scores, we will send you tailored weight management tips via email, which we will ask you to follow for a period of eight weeks. The tips you will receive will be for example:

"If you tend to overeat in response to the sight and/or smell of food, we would ask you to find alternatives to eating, such as going for a walk or taking different routes to work if you happen to walk past a shop that sells the treats you like the most".

We will send you weekly email reminders of the tips you should be following and ask you to complete a few questions on how you are getting on with following the tips. At the end of the eight weeks, we will ask you to report your weight and we would ask if you would let us interview you (via a phone call or skype session), to give us feedback as to whether you benefited from these tips, whether they were useful to you, easy to carry out, whether you would have preferred something different and how satisfied you felt with the results obtained. These interviews will be recorded so that they can be analyzed, however no mention of your name will be given and they will remain anonymous.

Appetitive trait weight management tips

5. Will I have to attend any meetings or sessions?

No, the whole intervention will be guided via email. You do not need to make any trips or attend any session. Once the intervention has finished, the last interview will be held via phone or via Skype.

Appetitive trait weight management tips

6. Will the information obtained in the study be confidential?

Only one researcher will have access to your contact email and information throughout the study. Once the study has finished, any personal contact information will be deleted. When interviews take place after the end of the intervention, confidentiality will be maintained as names will not be used when the interviews are written up. All collected data will be held confidentially and securely in accordance with the Data Protection Act 1998.

Appetitive trait weight management tips

7. Do I have to take part in the study?

It is up to you to decide whether or not to take part in the study. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. If you decide to take part you will be asked to sign a consent form that will be sent to you via email. You are still free to withdraw at any time without giving a reason and you can choose not to answer specific questions.

If you are interested in participating, it is important that you complete the following questions:

Appetitive trait weight management tips

8. Please answer the following questions

* 1. Could you please re-enter your email address

* 2. Could you please give us your first name

Appetitive trait weight management tips

9. Please answer the following question

* 3. In the next few months, will you be able to take part in this 8 week intervention?

Yes, I am interested in taking part

No, I will not be able to take part

Other (please specify)

Appetitive trait weight management tips

10. Please answer the following question

* 4. If you replied 'Yes' to the previous questions, will you be going away for any length of time which might make it difficult for you to follow the weight management tips you will be given:

- I will not be going away and will be able to follow the tips
- I will be going away, but I will be able to follow the tips
- I will be going away and I will find it difficult to follow the tips
- Other (please specify)

Appetitive trait weight management tips

11. Please answer the following question

* 5. If you will be going away from your usual routine this summer, how long will this be for:

- Only a few days
- One week
- Two weeks
- One month
- More than one month
- Other (please specify)

Appetitive trait weight management tips

12. Please answer the following question

* 6. Are you?

- Male
- Female

Appetitive trait weight management tips

13. Please answer the following question

7. Are you pregnant?

- Yes
 No

Appetitive trait weight management tips

14. Please answer the following questions

* 8. Do you have a terminal illness

- No
 Yes

Appetitive trait weight management tips

15. Please answer the following question

9. If you replied 'Yes', could you please state what this is?

Appetitive trait weight management tips

16. Please answer the following question

10. Do you have any illness(es) you would like to tell us about?

Appetitive trait weight management tips

17.

We hope that you will find this study of interest and will be willing to participate. If you are interested in knowing more about the study or if you have any further questions, please do not hesitate to contact Claudia Hunot: c.hunot.12@ud.ac.uk

Appendix 7.6 Weekly follow-up questionnaires (WFQ) (Study 4, Chapter 7)**Appetitive trait feedback intervention study: Weekly follow-up**

Could you please complete the following information:

1. The next few questions are about your **'food responsiveness'** tips.

Have you **avoided buying unhealthy foods and stopped having them in your home**, so that you aren't tempted to eat them?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you been able to **identify specific types of food that make you want to eat and tried to avoid them?**

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

When you have **been with others who are eating and it is not your mealtime, have you tried having a low calorie drink?**

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you **suggested doing things with friends that do not involve eating**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you **avoided going to the supermarket when hungry and used a shopping list**?

- All the time
- Most of the time
- A bit of the time
- None of the time
- Haven't been to the supermarket

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you tried to **train yourself to resist 'problem foods'**?

- Yes
- No

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I don't feel I am ready to carry out this tip
- I didn't find it difficult
- Other (please specify) _____

Overall, do you feel these tips are helping you to manage your **'food responsiveness'**?

- Yes
- No
- Some of them (please specify which ones) _____

Have you made any **weekly goals** for yourself to help you follow these tips?

- Yes
- No

2. These questions are about your '**emotional over-eating**' tip.

Have you made a **plan to comfort yourself with something other than food** when you are feeling upset, annoyed or anxious?

- Yes
- No

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Do you feel this tip has helped you to manage your '**emotional over-eating**'?

- Yes
- No

Have you made any **weekly goals** for yourself to help you follow this tip?

- Yes
- No

3. These questions are about your '**satiety responsiveness**' tips.

Have you **stopped and paid attention to how full you feel** half-way through your meal?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you been **eating the right portion sizes** for you and storing leftovers?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you tried **retraining yourself to eat smaller quantities of food**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you **stopped clearing your plate**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you avoided **mindless eating**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Overall, do you feel these tips are helping you to manage your '**satiety responsiveness**'?

- Yes
- No
- Some of them (please specify which ones) _____

Have you made any **weekly goals** for yourself to help you follow these tips?

- Yes
- No

4. These questions are about your **'fast eating'** tips.

Have you tried to **eat slower than those who are eating around you**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have you been **putting your fork down in between bites**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Have been **sitting down for your meals**?

- All the time
- Most of the time
- A bit of the time
- None of the time

What has made it difficult for you to follow this tip? Tick/strike/highlight the answers that have made it the most difficult for you to follow this tip this week.

- Time
- Self-motivation
- Lack of support from significant others
- I don't believe it will help
- This week has included different activities from my usual routine
- I didn't find it difficult
- Other (please specify) _____

Overall, do you feel these tips are helping you to manage your **'fast eating'**?

- Yes
- No
- Some of them (please specify which ones) _____

Have you made any **weekly goals** for yourself to help you follow these tips?

- Yes
- No

5. Are you currently following **any other program to help you manage your weight?**

Tick/strike/highlight the answers that apply.

- Self-directed weight loss program (e.g. following a low fat, low carbs, counting calories or in general trying to eat a healthy diet)
- Program-led weight loss (e.g. following a weight loss group, website app, or diet book)
- Strict elimination diet (e.g. fasting, using replacement meals)
- Increased physical activity
- Not following any other weight loss program
- Other (please specify) _____

Thank you for your time and remember to try and continue following the tips over the next week.

Appendix 7.7 Consent form for participation in the Appetitive Trait Tailored Intervention (ATTI) (Study 4, Chapter 7)

Informed Consent Form for Participants

Please complete this form after you have read the Information Sheet and return it to us signed via email to: c.hunot.12@ucl.ac.uk

Title of Project: **Appetitive trait feedback intervention study**

This study has been approved by the UCL Research Ethics Committee Project ID Number: 4378/003.

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you. If you have any questions arising from the Information Sheet given to you, please contact Claudia Hunot: c.hunot.12@ucl.ac.uk

Participant's Statement


I

- have read the Information Sheet, and understand what the study involves.
- have been advised who to contact if I have any other questions.
- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- consent to the processing of my personal information for the purposes of this research study and understand that it will not be used for any other purpose.
- understand that information provided will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
- agree that the research project named above has been explained to me to my satisfaction.
- agree to take part in this study.

Signed:

Date:

Appendix 7.8 Ethical approval, Study 4, Chapter 7

<p>UCL RESEARCH ETHICS COMMITTEE ACADEMIC SERVICES</p>	
<p>15 April 2015</p> <p>Professor Jane Wardle HBRC Department of Epidemiology and Public Health UCL</p> <p>Dear Professor Wardle</p> <p><u>Notification of Ethical Approval</u> <u>Project ID: 4378/003: Development and pilot testing of a brief feedback intervention concerning appetitive traits and exploratory analysis of food preferences in relation to weight tendencies in a sample of overweight and obese adults (proof of concept)</u></p> <p>I am pleased to confirm in my capacity as Chair of the UCL Research Ethics Committee that I have approved your study for the duration of the project i.e. until April 2016.</p> <p>Approval is subject to the following conditions:</p> <ol style="list-style-type: none"> 1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'. 2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported. <p><u>Reporting Non-Serious Adverse Events</u> For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.</p> <p><u>Reporting Serious Adverse Events</u> The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.</p> <p>On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.</p>	

With best wishes for the research.

Yours sincerely



Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc:
Claudia Hunot et al, Applicants
Professor R.G.Watt

Academic Service, 2 Taviton Street,
University College London Gower Street London WC1E 6BT
Tel: +44 (0)20 3108 4312
Email: ethics@ucl.ac.uk
<http://ethics.grad.ucl.ac.uk/>

Appendix 7.9 Number of tips given to each participant for high ‘food responsiveness’ and ‘emotional over-eating’ and low ‘satiety responsiveness’ and ‘slowness in eating’ scores (n=53) (Study 4, Chapter 7)

Participant ID	FR Mean	EOE Mean	SR Mean	SE Mean	No. of tips per participant (n)
1	3.75	3.2	2.75	1.25	4
2	3.75	2.6	2.5	3.75	2
3	3.5	2.6	3	2.25	2
4	4	3.6	2.25	3	3
5	4	3.8	2.5	2.5	4
6	4.25	3.4	2.25	2.75	4
7	3.5	2.8	3.75	2.75	2
8	3.25	3	2.75	2.5	3
9	3.75	3.4	2.75	1.75	4
10	4.25	3.4	3.25	4	2
11	4	2.6	2.5	3	2
12	4	3.4	2.5	2	4
13	4.25	3.4	2.25	1.5	4
14	3.25	2.6	2	2.25	3
15	4.25	3	2.5	2	3
16	3.75	3.2	2	1.75	4
17	3.25	2.8	3	3.5	2
18	3.25	2.8	2.75	1.75	3
19	3.25	2.4	3	3	1
20	4	3.4	2.75	2	4
21	3.5	3.6	3.5	2.5	3
22	3.5	2.4	3.5	2.5	2
23	4.5	3.2	3	3.5	2
24	5	3.4	3.5	4	2
25	4.75	3.2	3	1.5	3
26	3.75	3	3	2.25	2
27	4.25	2	2.25	2.25	3
28	4	2.6	2	4	2
29	2.5	3.4	3.5	2.25	2
30	3	2.8	2.5	2.75	2
31	4.5	3.8	3.5	3	2
32	4	3.2	2.25	1.5	4
33	4.5	3.2	2.5	1.25	4
34	3.25	3.8	2	2.25	4
35	3.5	3.4	3.75	4	2
36	3.5	3.2	3.25	2.75	3
37	4.5	3.8	2.25	1.75	4
38	3.75	3	2.5	2	3
39	3	2.6	3	2.5	1
40	4.75	3.2	2	1	4
41	3.5	3.4	2.5	2.25	4
42	3.5	2.8	3	2.75	2

Participant ID	FR Mean	EOE Mean	SR Mean	SE Mean	No. of tips per participant (n)
43	3.75	2.2	3.25	2.75	2
44	4.25	3.6	2	1	4
45	3.5	3.2	3	2.75	3
46	3.5	3.4	2.75	2.25	4
47	4.75	4.2	3	1	3
48	4	2.8	3.25	3.5	1
49	3.75	3.4	3.25	2.5	3
50	3.75	2.8	1.5	2.2	3
51	4	2.2	3.75	2.75	2
52	4.25	3.2	3.5	1.75	3
53	5	3.2	2	1.25	4
Tips given to participants n(%)	50 (94.3%)	31 (58.5%)	29 (54.7%)	42 (79.2%)	

High scores

Low scores

FR=Food responsiveness; EOE=Emotional over-eating; SR=Satiety responsiveness; SE=Slowness in eating.

Appendix 7.10 Initial BMI, final BMI, initial weight, final weight and change in weight for each participant in the appetitive trait intervention (n=53) (Study 4, Chapter 7)

Participant ID	Initial BMI Kg/m ²	Final BMI Kg/m ²	I-Weight (kg)	F-Weight (kg)	Weight change (kg)	Weight loss (%)
1	40.1	-	127	-	-	-
2	39.9	38.1	92.1	88	-4.1	10.7
3	34.0	33.3	83.9	82	-1.9	5.0
4	26.4	26.7	78.9	79.8	0.9	-2.3
5	32.3	33.0	91.2	93	1.8	-4.7
6	39.0	38.6	110	109	-1	2.6
7	28.5	-	70.3	-	-	-
8	27.3	27.0	74.4	73.5	-0.9	2.3
9	26.6	26.6	70.8	70.8	0	0.0
10	43.9	43.0	116.6	114.3	-2.3	6.0
11	38.2	37.9	101.6	100.7	-0.9	2.3
12	56.6	-	159.7	-	-	-
13	27.7	27.7	73.5	73.5	0	0.0
14	39.8	39.8	108.4	108.4	0	0.0
15	28.6	-	85.7	-	-	-
16	33.8	33.8	112	112	0	0.0
17	25.3	24.7	74.9	73	-1.9	5.0
18	36.6	36.1	90.3	88.9	-1.4	3.7
19	27.1	-	69.4	-	-	-
20	38.3	-	88.5	-	-	-
21	29.4	-	83	-	-	-
22	45.0	-	127	-	-	-
23	46.2	47.1	113.9	116.1	2.2	-5.7
24	36.1	36.1	84.4	84.4	0	0.0
25	28.6	28.6	82.6	82.6	0	0.0
26	43.7	43.5	116.1	115.7	-0.4	1.0
27	31.6	-	78	-	-	-
28	27.0	25.6	71.7	68	-3.7	9.7
29	36.3	-	102.5	-	-	-
30	31.8	31.6	85.5	85	-0.5	1.3
31	46.3	-	126	-	-	-
32	29.6	-	83.5	-	-	-
33	36.0	-	95.7	-	-	-
34	32.3	32.7	88	88.9	0.9	-2.3
35	29.4	29.0	68	67.1	-0.9	2.3
36	51.2	49.9	156.9	152.9	-4	10.4
37	30.2	29.8	74.4	73.5	-0.9	2.3
38	26.5	25.1	71.2	67.6	-3.6	9.4
39	29.7	30.4	85.7	88	2.3	-6.0
40	25.9	-	73	-	-	-
41	42.2	41.7	109.3	108	-1.3	3.4
42	33.5	-	88.9	-	-	-

Participant ID	Initial BMI Kg/m ²	Final BMI Kg/m ²	I-Weight (kg)	F-Weight (kg)	Weight change (kg)	Weight loss (%)
43	50.2	-	133.4	-	-	-
44	56.0	-	148.8	-	-	-
45	30.7	-	79.5	-	-	-
46	34.2	33.8	96.6	95.3	-1.3	3.4
47	28.5	27.0	77.6	73.5	-4.1	10.7
48	41.7	37.6	113.4	102.5	-10.9	28.4
49	27.1	27.7	70.3	71.7	1.4	-3.7
50	49.6	-	143.3	-	-	-
51	39.1	-	113	-	-	-
52	35.8	-	94	-	-	-
53	38.8	38.1	103	101.1	-1.9	5.0

Lost weight
 Gained weight
 Stayed the same weight

F: Final; I: Initial

Appendix 8.1 Semi-structured interview guide for participants of the 'Appetitive Trait Tailored Intervention' (ATTI) (Study 5, Chapter 8)

DEPARTMENT OF EPIDEMIOLOGY & PUBLIC
HEALTH
HEALTH BEHAVIOUR RESEARCH CENTRE



Appetitive trait feedback intervention study: Follow-up Interview – post eight week intervention

Topic guide

This topic guide is intended to ensure key aspects are covered during the interview. However a respondent-sensitive approach will be taken, allowing deviation from the order of the questions and raising additional issues if desired.

Introduction

Hello my name is Claudia Hunot. I was the researcher involved in the appetitive trait intervention you just carried out.

The **purpose of this interview** is: to 'explore your experience of the appetitive trait feedback intervention'.

I will be tape-recording this interview, do I have your permission to record this conversation?

I can assure you confidentiality will be kept and that names will not be used when this is written up.

Do you have in front of you (ask previously when arranging the interview) your appetitive trait tips?

Reasons for taking part in the study and invitation to take part in the study

What was the main reason you decided to take part in this study?

Probe: to improve lifestyle, to feel better about self, to be healthier, to help you to lose weight, or to maintain your weight.

What were your first thoughts when approached about the study via email?

Probe: What did you think the main purpose of the intervention was?

Did you perceive any initial drawbacks/did anything put you off?

Probe: anything in the email information sheet or the way you were approached?

What were you expecting from the intervention?

Appetitive trait intervention:

In general, how did you find the intervention?

How did you feel about being contacted via email? Was this easy for you to do/manage?

What did you think about the delivery of the tips in this way?

When you received your tips in a pdf format, did you like this? Would you have preferred to receive them a different way?

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What did you think about the first slide/page? The one that contained the information about appetitive traits.

Probe: Was the information new to you? Was it clear? Was the information credible/trustworthy/reliable?

Did you understand what the term appetitive traits meant?

What did you think about your appetite profile?

Probe: Did you agree with the appetitive traits that could be making things more difficult for you? Did you find them surprising? Could you relate to them? If not, why?

What did you think of the fact that they were personalised tips for your traits?

Probe: Did you like that?

Moving on to each specific trait you have and the tips you received for each:

I shall now ask you some questions about your '**food responsiveness**' trait tips.

What did you think of the 'food responsiveness' tips in general?

Probe: Did you understand them? Did you find them credible/trustworthy/reliable? Did they give you new information you didn't know about?

Which ones of the FR tips did you use?

Did you find them easy to carry out? Effective? Why?

Which ones of the FR tips did you find difficult to carry out?

Were there any tips did you not do at all?

Probe: For what reason/s?

Did the FR tips give you enough information to make the necessary changes to your behaviour?

Probe: Did you feel comfortable/happy/equipped?

What made it difficult for you to change your behaviours?

Probe: time, practical issues, motivation, family, conflicts with identity, emotion, etc.

Is there anything else you would have liked included in these tips?

Probe: would you have liked more detail? More information? Other suggestions?

*****Remember to ask about any tips they didn't mention*

And now I shall move on to '**emotional over-eating**' trait tips.

What did you think of the 'emotional over-eating' tips in general?

Probe: Did you find them credible/trustworthy/reliable? Did you understand them? Did they give you new information you didn't know about?

Which ones of the EOE tips did you use?

Did you find them easy to carry out?

Did you find them effective? Why?

Which ones of the EOE tips did you find difficult to carry out?

Were there any tips did you not do at all?

Probe: For what reason/s?

Did the EOE tips give you enough information to make the necessary changes to your behaviour?

Probe: Did you feel comfortable/happy/equipped?

What made it difficult for you to change your behaviours?

Probe: time, practical issues, motivation, family, conflicts with identity, emotion, etc.

Is there anything else you would have liked included in these tips?

Probe: would you have liked more detail? More information? Other suggestions?

*****Remember to ask about any tips they didn't mention*

And now onto a few questions about your '**satiety responsiveness**' trait tips.

What did you think of the 'satiety responsiveness' tips in general?

Probe: Did you find them credible/trustworthy/reliable? Did you understand them? Did they give you new information you didn't know about?

Which ones of the SR tips did you use?

Did you find them easy to carry out?

Did you find them effective? Why?

Which ones of the SR tips did you find difficult to carry out?

Were there any tips did you not do at all?

Probe: For what reason/s?

Did the SR tips give you enough information to make the necessary changes to your behaviour?

Probe: Did you feel comfortable/happy/equipped?

What made it difficult for you to change your behaviours?

Probe: time, practical issues, motivation, family, conflicts with identity, emotion, etc.

Is there anything else you would have liked included in these tips?

Probe: would you have liked more detail? More information? Other suggestions?

*****Remember to ask about any tips they didn't mention*

And finally I'd like to ask you a few questions about your '**fast eating**' trait tips.

What did you think of the 'fast eating' tips in general?

Probe: Did you find them credible/trustworthy/reliable? Did you understand them? Did they give you new information you didn't know about?

Which ones of the 'fast eating' tips did you use?

Did you find them easy to carry out?

Did you find them effective? Why?

Which ones of the 'fast eating' tips did you find difficult to carry out?

Were there any tips did you not do at all?

Probe: For what reason/s?

Did the 'fast eating' tips give you enough information to make the necessary changes to your behaviour?

Probe: Did you feel comfortable/happy/equipped?

What made it difficult for you to change your behaviours?

Probe: time, practical issues, motivation, family, conflicts with identity, emotion, etc.

Is there anything else you would have liked included in these tips?

Probe: would you have liked more detail? More information? Other suggestions?

*****Remember to ask about any tips they didn't mention*

In general did use the **goal setting** slide/page?

Did you set any goals for yourself?

Probe: Did it help you track your progress? Did you find it useful?

Which trait did you set yourself goals for?

Probe: Why?

I have finished asking you questions about the appetitive trait pdf format.

I would now like to ask you about the **weekly reminders** I sent you via email. *****Remember to have a note of how many questionnaires they returned*

What did you think of these weekly reminders?

Probe: Was it helpful to be reminded to continue following the tips?

Did you like the frequency with which they were sent to you?

Probe: Would you have liked more/less reminders?

Did you like the way they were delivered? Via email?

Probe: Would you have preferred a different form delivery?

Along with the reminder email, I sent you a **weekly follow-up questionnaire**.

What did you think of the weekly follow-up questionnaires?

Probe: Were they helpful? Easy to fill out?

Did you like the way they were delivered? Via email?

Probe: Would you have preferred a different form delivery?

Finally, just a **few more questions**.

How **satisfied did you feel** with the results of the study? ****Reword if they have said throughout they didn't like it/feel satisfied*

How would you rate the brief tailored appetitive trait feedback intervention as a weight loss programme overall?

Probe: On a scale of 1 to 10, where 1 was a 'didn't like it at all' to 10 'I found it great/excellent', what score would you give it?

Do you feel any different in yourself? In your weight?

Do you think you have made changes that have improved your lifestyle?

How does it compare to other programmes/advice?

Would you recommend them to other people who would like to lose weight?

What part of the intervention was most helpful for making a change to your behaviours?

Probe: was it the information provided, the reminders, the planning (goal setting), others

Did other things that were not part of the intervention itself help?

Probe: family/friends, self-rewards, goal setting, information from websites

Did you get support from a friend/spouse/partner/family member i.e. help you to stick to the tips?

Would you have made changes to your behaviours had you not taken part in the intervention?

And **finally**

What would you change about the study?

Probe: would you like to add anything extra, such as personal contact, more information on diet, recipes, a newsletter, etc.

Do you think you will continue with the changes you have made?

Probe: What do you think will happen if you do/don't continue?

Are there things that might interfere with you continuing following the tips?

Probe: will you have to think about doing them/remember?

Are there incentives for continuing with them?

Is there anything else you would like to say about the study?

I would like to finish by **thanking you for your time** on the study and during this interview

Thank you again, and if you have any further comments/questions don't hesitate to contact me (Claudia Hunot) at any time.

Appendix 8.2 Consolidated criteria for reporting qualitative research (COREQ); 32 item checklist (Study 5, Chapter 8)

No	Item	Guide questions/description
Domain 1: Research team and reflexivity		
Personal characteristics		
1	Interviewer/facilitator	Which author conducted the interviews?
2	Credentials	What were the researcher's credentials?
3	Occupation	What was their occupation at the time of the study?
4	Gender	Was the researcher male or female?
5	Experience and training	What experience or training did the researcher have?
Relationship with participants		
6	Relationship established	Was a relationship established prior to study commencement?
7	Participant knowledge of the interviewer	What did the participants know about the researcher?
8	Interviewer characteristics	What characteristics were reported about the interviewer?
Domain 2: Study design		
Theoretical framework		
9	Methodological orientation and theory	What methodological orientation was stated to underpin the study?
Participant selection		
10	Sampling	How were participants selected?
11	Method of approach	How were participants approached?
12	Sample size	How many participants were in the study?
13	Non-participation	How many people refused to participate or dropped out? Reasons?
Setting		
14	Setting of data collection	Where was the data collected?
15	Presence of non-participants	Was anyone else present besides the participants and researchers?
16	Description of the sample	What are the important characteristics of the sample?
Data collection		
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?
18	Repeat interviews	Were repeat interviews carried out? If yes, how many?
19	Audio/visual recording	Did the researcher use audio or visual recording to collect the data?
20	Field notes	Were field notes made during and/or after the interview?
21	Duration	What was the duration of the interviews?
22	Data saturation	Was data saturation discussed?
23	Transcripts returned	Were transcripts returned to participants for comment and/or corrections?
Domain 3: Analysis and findings		
Data analysis		
24	Number of data coders	How many data coders coded the data?
25	Description of the coding tree	Did authors provide a description of the coding tree?
26	Derivation of themes	Were themes identified in advance or derived from the data?
27	Software	What software, if applicable, was used to manage the

28	Participant checking Reporting	data? Did participants provide feedback on the findings?
29	Quotations presented	Were participant quotations presented to illustrate the themes? Was each quotation identified?
30	Data and findings consistent	Was there consistency between the data presented and the findings?
31	Clarity of major themes	Were major themes clearly presented in the findings?
32	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?

Source: Tong, Sainsbury, & Craig, 2007

Appendix 8.3 Appetitive traits tips given, Initial BMI, final BMI, initial weight, final weight and change in weight for each participant interviewed after the appetitive trait intervention (n=21) (Study 5, Chapter 8)

Participant ID	FR Mean	EOE Mean	SR Mean	SE Mean	Initial BMI Kg/m ²	Final BMI Kg/m ²	I-Weight (kg)	F-Weight (kg)	Weight change (kg)
2	3.75	2.6	2.5	3.75	39.9	38.1	92.1	88	4.1
4	4	3.6	2.25	3	26.4	26.7	78.9	79.8	-0.9
6	4.25	3.4	2.25	2.75	39.0	38.6	110	109	1
8	3.25	3	2.75	2.5	27.3	27.0	74.4	73.5	0.9
9	3.75	3.4	2.75	1.75	26.6	26.6	70.8	70.8	0
10	4.25	3.4	3.25	4	43.9	43.0	116.6	114.3	2.3
13	4.25	3.4	2.25	1.5	27.7	27.7	73.5	73.5	0
16	3.75	3.2	2	1.75	33.8	33.8	112	112	0
17	3.25	2.8	3	3.5	25.3	24.7	74.9	73	1.9
18	3.25	2.8	2.75	1.75	36.6	36.1	90.3	88.9	1.4
23	4.5	3.2	3	3.5	46.2	47.1	113.9	116.1	-2.2
25	4.75	3.2	3	1.5	28.6	28.6	82.6	82.6	0
26	3.75	3	3	2.25	43.7	43.5	116.1	115.7	0.4
28	4	2.6	2	4	27.0	25.6	71.7	68	3.7
30	3	2.8	2.5	2.75	31.8	31.6	85.5	85	0.5
35	3.5	3.4	3.75	4	29.4	29.0	68	67.1	0.9
37	4.5	3.8	2.25	1.75	30.2	29.8	74.4	73.5	0.9
41	3.5	3.4	2.5	2.25	42.2	41.7	109.3	108	1.3
46	3.5	3.4	2.75	2.25	34.2	33.8	96.6	95.3	1.3
47	4.75	4.2	3	1	28.5	27.0	77.6	73.5	4.1
48	4	2.8	3.25	3.5	41.7	37.6	113.4	102.5	10.9

FR=Food responsiveness; EOE=Emotional over-eating; SR=Satiety responsiveness; SE=Slowness in eating.