A Systematic Review of the Association between Emotions and Eating Behaviour in Normal and Overweight Adult Populations

Abstract

A systematic review was completed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive search of four electronic databases (2004-2015) yielded 60017 articles, of which 29 met inclusion criteria. Included studies performed poorly on data quality analysis in terms of randomization and controlling for confounding factors. Participant's BMI scores range from 19.73 (SD = 1.54) to 28.4 (SD = 1.4) kg/m^2. Where positive and negative affect were compared, food was more likely to be consumed in response to positive affect. With regards to discrete emotions; stress, depression, and sadness consistently elicited eating behaviours that fall outside of nutritional recommendations (e.g., increased food intake, poor nutritional food choices). The role of moderators including individual differences in dietary restraint and emotional eating, as well as methodological considerations, such as means of eliciting and measuring emotions, may account for equivocality with regards to some emotion and eating associations. The paper concludes with recommendations for future research and implications for practice.

Keywords: emotional eating, self-regulation, restrained eating, eating behaviour, emotions

It is widely accepted that emotions can bring about changes in eating behaviour (Greeno and Wing, 1994). Negative emotions and indeed stress are said to produce physiological sensations resembling satiety; where we would naturally expect to see decreases in appetite and food intake (Wing et al., 1990). Emotional eating is a term used to describe increased eating in response to negative emotions, whereby emotions are said to be regulated by food intake (Christensen, 1993; Macht, 2008). Emotionally elicited eating is of interest to researchers and practitioners as it has been associated with a failure to maintain weight management goals in overweight and obese individuals (Elfhag and Rössner, 2005). In a systematic review of emotions and eating behaviour (Nicholls, Devonport, and Blake, 2016), negative mood, sadness, tension and instability of emotions were found to be antecedents of binge eating in an adult BED-Obese sample. In order to build on this synthesis of existing literature, there is utility in understanding emotion and eating associations in non-clinical normal and overweigh adult populations. A systematic review of emotions and eating behaviour undertaken with these populations may provide knowledge on variables implicated in increasing vulnerability towards becoming obese. This may inform early community-based interventions intended as obesity prevention or awareness raising measures (Carter and Jansen, 2012).

Negative emotions have arguably received the most attention in eating related research, yet less is known about the roles of discrete emotions (with the exception of depression and stress), and so it is unclear whether they elicit varying effects on eating behaviour (Nicholls, Devonport, and Blake, 2016). For example, emotions such as anxiety and depression may interfere with one's motives or desires for eating (Macht and Simons, 2000; Rousset et al., 2008). Although there is little research on positive emotions and eating behaviour (Tchanturia et al., 2015), it is plausible that eating in response to a positive emotion state diverts attention to the cause of the positive emotion, disrupting the conscious

restriction of food intake (Jansen and van den Hout, 1991). Increased eating in response to emotions may be of particular interest when we consider its potential to undermine weight loss and weight maintenance efforts.

The purpose of this paper was to offer a comprehensive review of the reported associations between emotions and eating behaviour in normal and overweight adults. The aims were to review the associations between discrete emotions and eating behaviours, identify variables that modify these associations, and offer a critique of the extant literature.

METHOD

To ensure methodological rigour we adhered to the standard methodology for systematic reviewing (Higgins and Green, 2008). The aims, inclusion criteria, data extraction, and data quality evaluation were specified at the outset to ensure objectivity and replicability. The review was registered on PROSPERO (CRD42014013138).

Searches

A systematic search of electronic databases was undertaken, identifying literature published over a period between July 2004 and September 2015. The rationale being that a systematic review conducted in 2004 (National Institute of Clinical Excellence (NICE), 2004) concluded there was insufficient knowledge on the nature of atypical eating to inform interventions. In addition, there has been a marked increase in severe obesity from 2004-2014 (Public Health England (PHE), 2015), therefore understanding atypical eating behaviours which may contribute to obesity is critical.

Where databases allowed (Medline), the search was delimited to ‘human only’ studies, and all searches were restricted to studies presented in the English language. No other restrictions were applied. PsychINFO, Medline, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and SportDiscus were searched using terms related to emotions, consumption of food, and regulation (see appendix A for example search). In

addition, the knowledge update from the National Obesity Observatory was hand-searched for the last ten years for relevant papers.

Since it was of key importance that the present review captures the full range of emotions represented in existing literature, the search terms for emotion were derived from four measures of emotion (Crawford and Henry, 2004, Hanin, 2000, McNair et al.,1981; Terry et al., 2003).

Inclusion Assessment

Citations were managed using Endnote. The search yielded 60017 references (see Figure 1). After deduplication, 49646 titles were independently screened by two reviewers. Where there was disagreement, the full text manuscript was consulted by both reviewers to reach agreement. For a paper to be included, there had to be consensus that the following criteria were met:

(a) Empirical research (e.g., not case studies, letters and commentaries);

(b) Published in a peer reviewed journal;

(c) Measured, assessed (quantitative), or discussed (qualitative) emotion or emotional eating;

(d) Measured, assessed (quantitative), or discussed (qualitative) eating or eating behaviour;

(e) Positioned emotions as a causal factor in contributing to eating behaviour (i.e., papers describing emotions occurring as a result of eating were excluded);

(f) Participant's Reported mean BMI falls within 20-30kg/m^2, and as normal weight range is reported to be within 18–25kg/m^2 (Royal and Kurtz, 2010), reported SD must indicate a range of BMI from 18 kg/m^2 not exceeding 31kg/m^2;

(g) Adult population.

243 papers were screened for full inclusion. Of these 214 papers were excluded. The papers excluded at full screen were; 53 which did not report on an association of interest, 36 where data were collapsed across groups and no analyses of relevance could be extracted, 35

which did not report BMI and so inclusion assessment could not be completed, 40 papers where participants did not meet BMI inclusion criteria, 9 papers with no measure of emotion, 19 where participants were classified as having binge eating disorder, anorexia or bulimia nervosa, or demonstrated purging behaviour, 5 narrative reviews, 4 unpublished theses, 4 focussed on child populations, 3 which were not subject to peer review, 3 with no measure of eating or eating behaviour, 1 animal study, 1 case study, and 1 addendum to an included paper.

Data Extraction

Data extraction parameters were established in line with research questions and managed using Excel. Data extraction headings facilitated the capture of pertinent information including details concerning samples, measures, participant reported outcomes concerning emotions and eating behaviour, research limitations and implications for practice.

Data Quality

Quality of included papers was assessed by all authors using the standard quality assessment for evaluating primary research papers (Kmet et al., 2004). Inter-rater agreement was assessed for a subset and was within an acceptable range (n = 5, range κ = .774 - .900). Studies were evaluated based on 20 criteria spanning design, sampling, methodology, analysis, results and conclusions. For each criterion, papers scored either 2 (good), 1 (partial fulfilment), 0 (not fulfilled), or X (not relevant) (possible score range 0-2). A mean score was calculated for each paper to give an overall rating of quality. In addition, a mean score for each of the sub-criteria was used to indicate the relative strengths and limitations across all 29 included studies.

RESULTS

Characteristics of the Included Studies

Of the 29 included studies (Table 1), two studies were mixed methods, 26 utilized quantitative methods, and one used qualitative methods. The included studies were largely of Western origin including USA (n = 11), UK (n = 2), Netherlands (n = 8), Germany (n = 5), Greece (n = 1), Taiwan (n = 1) and China (n = 1). Participant's BMI scores range from 19.73 (SD = 1.54) to 28.4 (SD = 1.4) kg/m^2. The mean age ranged from 18.6 (SD = 0.1) to 33.6 (SD = 9.4) years, with percentage of females ranging from 50% to 100%.

[Insert Table 1 about here]

Data Quality

The possible range of scores on the quality assessment was 0-2, with a higher score indicating better quality (Kmet et al., 2004). The mean scores (SD) for individual studies are presented in Table 1. The mean score for data quality was 1.68 (SD = 0.16). The range was 1.14 (SD = 0.66) (Macht et al., 2005) – 1.93 (SD = 0.26) (Wallis and Hetherington, 2004). Six studies scored more than one standard deviation below the sample mean (Crockett et al., 2015; Evers et al., 2009; Hilbert et al., 2011; Macht et al., 2005; Royal and Kurtz, 2010; Sproesser et al., 2011). Consequently, whilst these studies are included and contribute toward a useful critique of existing literature, their findings should be interpreted with caution.

The mean scores (SD) for individual indicators of quality across all quantitative studies are presented in Table 2 (n = 28). Studies overall performed well on having a follow up (applies to 6 studies), describing the trial and describing those lost to follow up, specifying a clear hypothesis and design, and use of suitable and validated predictor and outcome measures. Studies using a manipulation did not perform well on randomization. Studies also

performed poorly on controlling for confounding factors and describing samples, with many papers lacking detail on the ethnicity of participants.

[Insert Table 2 about here]

Narrative Synthesis of Findings

To facilitate interpretation of data, findings will be organised and presented by study design. A number of eating behaviours are evaluated in included studies, including binge eating, emotional eating, amount of food consumed (measured), and amount of food consumed (reported). This is important to note, as discrepancy in the type of eating behaviour investigated may influence findings.

Qualitative

One qualitative paper (Bennett et al., 2013) examined triggers for emotionally elicited eating behaviour over a three-day period using a food journal and in-depth interviews (n = 16). Young individuals were purposively selected who scored highly on emotional eating. Females spoke of university stress increasing food consumption, whilst males stated that stress was more likely to decrease consumption. The primary trigger for eating in females was stress, frequently followed by guilt, whilst males identified boredom or anxiety. Coping with stress through eating was identified as a significant barrier to healthy eating across genders.

Non-experimental Associations between Emotions and Eating

Two studies found emotional eating to be significantly correlated with self-reported overeating (Macht and Mueller, 2007; Van Strien et al., 2009). That is, individuals reporting eating in response to negative emotions, also reported overeating. When exploring associations between specific emotions and eating among female Greek students, 36.7% reported that stress had no effect on their eating behaviour, 35% reported eating more in response to stress, and 28.3% reported that they normally eat less than usual during stress

(Costerelli and Patsai, 2012). Among Chinese students, Zhu, Cai, and Chen (2013) reported a higher score for eating in response to positive emotions when compared to depression, anxiety and anger. Furthermore, sex differences emerged in that females were more likely to eat in response to depression and anxiety than were males. In a further study, difficulties with emotion regulation were associated with more emotional eating behaviour in response to boredom and 'other' emotions (summed subscales for depression, anxiety, and anger) (Crockett et al., 2015). Binge-eating behaviour was associated with aggression and depression in a healthy sample (Slane et al., 2010), and with depression among a sample of female undergraduate students (Kelly et al., 2014).

Regarding food choice, highly palatable foods such as chocolate, followed by crisps and ice cream were preferred during stressful times (Costerelli and Patsai, 2012). Emotional eaters reported more intense chocolate cravings, higher chocolate consumption, and less chocolate related guilt than restrained eaters (Macht and Mueller, 2007). When individuals were motivated to choose foods to regulate negative affect, this was associated with a less healthy dietary pattern, compared with being motivated to choose food for weight loss (Sproesser et al., 2011).

When exploring associations between emotions and eating, some authors performed subgroup comparisons. For example, Tomiyama, Dallman, and Epel (2011) used perceived stress scores to classify healthy premenopausal women into extreme quartiles of low versus high stress groups. Greater emotional eating was reported in women high in chronic stress when compared to women low in chronic stress. In a secondary analysis undertaken by Zhu et al. (2013), Chinese students were categorised into three groups according to whether they ate in response to positive emotion, negative emotion, or were normal eaters. Those who ate in response to negative emotions reported experiencing more anxiety, depression, and hostility than those who ate in response to positive emotions and normal eaters. In addition,

those classified as ‘positive emotional eaters’ reported experiencing more anxiety and hostility than did normal eaters.

Experimentally induced emotions and eating behaviour

Studies commonly induced emotion experimentally utilising idiosyncratically relevant emotion situations generated from participant’s memory. Where a recall technique was used to compare the effect of positive and negative emotion induction on food consumption, both ate more than the control condition, but there was no difference between groups (Evers et al., 2013). Schneider et al. (2010) asked lean participants to complete three counterbalanced experimental sessions involving different mood inductions (neutral, anxiety, anger). Similar to the previous findings, no significant difference in subsequent food intake was observed between experimental groups. However, other studies have found an influence.

Hilbert et al. (2011) induced stress with findings indicating a corresponding rise in desire to binge from baseline to post emotion-induction. Chao, Yang, and Chiou (2012) assigned participants to one of three induction study conditions (shame, guilt, or neutral). Shamed participants ate more nougat than participants in the neutral and guilt conditions, with no difference between guilt and neutral conditions. Notably, Chao et al. (2012) excluded restrained eaters, a factor that has shown to influence the emotion and eating relationship (Greeno and Wing, 1994).

Other methods were used to induce emotions. Using films, Evers et al. (2013) found those in the positive emotion condition consumed more than participants in negative or neutral conditions. Where stress was induced using the Trier Social Stress Test (TSST; Van Strien et al., 2013a), mean food intake did not significantly differ from that in the control condition. In response to stress induced following a maths test, participants with high visceral adiposity showed a higher mean food ‘wanting’, ‘wanting’ for dessert and snacks, and their energy intake, carbohydrate and fat intake were higher in the absence of hunger in the stress

versus rest condition, whereas this effect was not found for normal weight participants (Lemmens et al., 2011).

Psychometrically Determined Subgroups

An alternative methodological approach was to compare the effect of an experimental condition between psychometrically determined subgroups. Evers et al. (2009) induced negative and positive affect in a group of female students. Those in the positive emotion conditions consumed more food following emotion induction than participants in negative or neutral conditions. However, on further analysis, self-reported emotional eaters did not eat more than non-emotional eaters in any of the experiments. In addition, the amount of food consumed when feeling negative did not predict self-reported emotional eating. Similarly, Royal and Kurtz (2010) found no effect of emotional eating on the food consumption of female undergraduate students after low-stress (solving easy anagrams) or high-stress (working on unsolvable anagrams) conditions.

In a series of studies, Van Strien and colleagues examined whether it was possible to predict distress-induced eating when categorizing individuals as a high or low emotional eaters. Van Strien et al. (2012) found that low emotional eaters ate less during a sad movie than during a neutral movie, whereas high emotional eaters ate more. In a follow up study (Van Strien et al., 2013b), low emotional eaters ate similar amounts after sad and joy mood conditions (elicited with movie clips); whilst high emotional eaters ate significantly more after the sad mood condition than after the joy mood condition. Van Strien et al. (2013a) measured difference in actual food intake after a control condition or the TSST. High emotional eaters with a blunted cortisol stress response ate more food after distress than those with an elevated cortisol stress response, whilst low emotional eaters showed no such relationship. These findings were later replicated (Van Strien et al., 2014) as low emotional eaters ate less after distress than after control conditions, and high emotional eaters ate more.

Collectively, this research highlights the importance of subgroup analysis in exploring emotional eating in experimental settings.

Tryon, DeCant, and Laugero (2013) categorized women as high chronic stress or low chronic stress based on Wheaton Chronic Stress Inventory scores (Wheaton, 1994), and saliva samples were used to determine stress-induced cortisol reactivity. Low and high acute stress groups were established by taking a median-split. Participants completed both a control task and the TSST, with each visit occurring one month apart. At 60-minutes post stress and control session, women reporting higher chronic stress and exhibiting low cortisol reactivity to the acute stress task consumed significantly more calories from chocolate cake on both stress and control visits. High stress cortisol reactors did not show differences in chocolate cake consumption. In other words, trait as opposed to state stress appeared to influence food intake.

Research exploring the effects of dietary restraint on the association between emotion and eating produced inconsistent findings. Macht and Mueller (2007) found that healthy participants who scored highly on both emotional eating and restrained eating showed highest levels of negative affect. Evers et al. (2013) found the association between positive emotions and food consumption was not moderated by dietary restraint. Similarly, Royal and Kurtz (2010) found participants in a high stress condition ate significantly more than participants in the low stress condition regardless of their dietary restraint.

The interaction between restrained eating and stress on food choice was explored in four studies. Shapiro and Anderson (2005) classified participants as restrained or non-restrained using a median split, and then randomly assigned them to either a stress (unsolvable anagrams) or no-stress (finding letters in a passage of text) condition. Both groups participated in a taste test using several classes of foods (high fat/high sugar; low fat/high sugar; high fat/low sugar; low fat/low sugar). Restrained eaters did not consume

more total calories under stress, when compared to those not under stress. However, there was a trend in food choice; restrained eaters under stress consumed more high fat-low sugar snacks than restrained eaters who were not under stress. Similar findings emerged in a later study by Habhab, Sheldon, and Loeb (2009), who explored the food types that female students consumed in response to stress induction using Sudoku puzzles; comparing foods that varied in fat, sugar, and salt. In support of Shapiro and Anderson (2005), more high-fat food was eaten by those in the high restraint group when compared to low restraint, regardless of stress condition. Wallis and Hetherington (2004) found that under stress conditions more chocolate was consumed. High restraint, low emotional eating participants consumed more chocolate under stress conditions than low restraint, low emotional eating participants. Conversely, Wallis and Hetherington (2009, study 2) found that restrained eaters consumed significantly less after stress conditions than after the neutral conditions, but this was associated only with intake of the low fat snack.

Sleep has also been explored as a potential mediator of the association between emotions and eating. Dweck, Jenkins, and Nolan (2014 - experiment 2) examined whether sleep duration interacted with stress and emotional eating to affect food consumption among females. Participants were grouped into high and low emotional eaters, divided into short (<7 h/night) and normal (≥7 h/night) sleepers, and then provided with snacks under stressed (required to solve Sudoku puzzles) and control conditions. Whilst there was no effect of stress or sleep duration on the amount of cookies consumed in the group of low to moderate emotional eaters, high emotional eaters ate more cookies in the stress condition, and short sleep predicted higher cookie consumption among high emotional eaters in the control condition.

Naturally Occurring Emotions and Eating Behaviour

Evers et al. (2013) used a 7-day diary to record snacking and emotions as they

occurred in the natural environment. Consistent with their lab-based findings (Evers et al., 2009; Evers et al., 2013 studies 1 and 2), they found that participants reported eating in response to positive emotions more frequently than negative emotions. Wallis and Hetherington (2009, study 1) compared retrospective self-reported changes in snack intake for emotional and non-emotional eaters during times of stress. Groups were based on a median split of scores on the DEBQ (Van Strien et al., 1986). Female students self-reporting as emotional eaters were more likely to report overeating in response to a specific stressor than non-emotional eaters, and non-emotional eaters were more likely to report under-eating. Three snack foods (crisps, chocolate, biscuits) were all more likely to be eaten in times of stress with emotional-eaters reporting overeating biscuits and crisps to a larger extent than the non-emotional eaters. All participants reported over-consumption of chocolate in times of stress.

Two studies explored associations between emotions and eating during naturally occurring stressful (exam/test) and control conditions. Costerelli and Patsai (2012) found that among Greek female University students, emotional eating was significantly correlated with stress in the exam period but not in the control period. Macht et al. (2005) found that stress (exam) and control (no exam) group participants did not differ significantly in self-rated emotions during baseline, but 3-4 days before the exam the stress group showed higher ratings of tension, fear and emotional stress as well as lower ratings of happiness, relaxation and positive mood; with a corresponding higher tendency to eat in order to distract from stress.

Emotions and Eating with Intervention

One study trained participants to either suppress emotion, accept emotion, or re-appraise emotion in response to a video clip to induce sadness (Svaldi et al., 2012). For participants with high dietary restraint both the acceptance and suppression conditions

resulted in a higher desire to eat following the video clip, with no change for reappraisal. There were no significant effects for participants with low restraint.

DISCUSSION

Consistently, participants ate more in response to general positive affect, when compared with general negative affect (Evers et al., 2009; Evers et al., 2013; Zhu et al., 2013). Van Strien et al. (2013b) explored associations between discrete emotions (Joy, Sad) and eating, with high emotional eaters eating significantly more after the sad mood condition than after the joy mood condition. Macht et al. (2005) found that before an exam, stress group participants reported higher ratings of negative emotion (tension, fear, emotional stress) and lower positive emotion (happiness, relaxation, positive mood); with a corresponding higher tendency to eat in order to distract from stress. These findings highlight the importance of capturing positive and negative emotions when examining associations with eating behaviours (Tchanturia et al., 2015). Not only might positive emotion associate with eating as indicated in the present review (Evers et al., 2009; Evers et al., 2013; Zhu et al., 2013), but as also indicated, an absence of pleasant emotion when experiencing unpleasant emotion may be influential (Macht et al., 2005). The finding that positive emotions can influence eating (Bongers et al., 2013) makes intuitive sense when one considers the use of food as part of social rituals (e.g., birthdays, weddings, religious events; Desmet and Schifferstein, 2008). It follows that, whilst individuals may not necessarily be using food to regulate positive emotion; positive emotions may trigger increased intake through associative learning. Alternatively, a positive emotional state may divert attention to the origin of the positive emotion, disrupting the conscious restriction of food intake (Jansen and van den Hout, 1991).

When exploring negative emotions and eating behaviour, stress was the most commonly explored discrete emotion. Chronic stress (Tryon et al., 2013) and trait stress (Tomiyama et al., 2011) were both associated with higher food consumption, with people

eating more during stressful periods (Costerelli and Patsai, 2012; Macht et al., 2005; Royal and Kurtz, 2010). However, depression and sadness were also reported to be antecedents of eating behaviour (Van Strien et al., 2013b) and binge eating (Kelly et al., 2014; Slane et al., 2010). Boredom proneness and emotional eating demonstrated strong positive correlations (Crockett et al., 2015), and shamed individuals ate more in a taste test experiment with no effect for guilt (Chao, et al., 2012). Aggression/anger was positively correlated with emotional eating (Zhu et al., 2013) and with binge-eating behaviour in a healthy sample (Slane et al., 2010).

Emotion was also found to affect the type of food consumed. Feeling stressed influenced food choice towards more palatable and less healthy meals (Costerelli and Patsai, 2012; Wallis and Hetherington, 2004, 2009), whilst motivation to eat in order to regulate negative affect was associated with an unhealthy dietary pattern (Sproesser et al., 2011). The results suggest that negative emotions can elicit unhealthy eating behaviour, poor food choices, with food being used to regulate stressful or negative emotions in normal and overweight individuals. When one considers the demands of daily life, using unhealthy food to regulate negative emotional states may well contribute to a steady increase in weight gain over time.

Given the complexity of associations between emotions and eating, researchers have begun to explore moderators in an attempt to better explain emotionally elicited eating behaviour. As an illustrative example, research indicates that those who score highly on emotional eating tend to eat more under stress (Van Strien et al., 2012; Van Strien et al., 2013a; Van Strien et al., 2014), and sadness (Van Strien et al., 2012 - study 1) than those with low scores for emotional eating. Further, this relationship appears to be exacerbated by personal factors, such as when individuals high in emotional eating experience short sleep (Dweck et al., 2014). In contrast to these findings, Royal and Kurtz (2010) found no effect of

emotional eating on food consumption under high stress conditions. However, it is worth noting whilst Van Strien and colleagues identified individuals as high or low emotional eaters using an inter-quartile range, Royal and Kurtz (2010) used a 'median split'. Studies using a median split to compare two groups (see also Hahab, 2009; Tryon et al., 2013; Wallis and Hetheringon, 2009 - study 1) have been criticised as this method may misclassify individuals leading to a null result. Indeed, Van Strien et al. (2012) highlighted that their findings would have been non-significant if a median split had been used.

Emotional eating may moderate the association between emotions and eating behaviour through a negative maintenance cycle. Specifically, the weight change that emotional eating may incur (Drapeau et al., 2003) can lead to negative psychological outcomes, which in turn leads to higher levels of emotional eating (Van Strien et al., 2005). Macht and Mueller (2007) called for longitudinal research to explore the causal order to establish whether increased negative affect leads to eating, or whether eating predisposes individuals to increased negative affect.

Whilst moderators of effect present one evidenced explanation for equivocality with regards to emotions and eating behaviour, the range of methodological approaches utilized present further plausible explanations. Self-report was commonly used; however, such measures did not always correspond to behaviour. Self-identified emotional eaters did not eat more than non-emotional eaters following experimental mood induction (Evers et al., 2009). Furthermore, the amount of food consumed when feeling negative affect did not predict self-reported emotional eating. This presents a significant limitation and questions how competent people are in assessing their own emotional eating behaviour (Evers et al., 2009). Research indicates that people may be biased towards under-reporting eating (Evers et al., 2009), and may also under-estimate or over-estimate recalled emotions (Ready et al., 2007). For emotional eating scales this potentially presents a triple recall bias as individuals are required

to recall their negative emotions, their food intake, and the association between both. However, researchers have identified considerations that may increase the reliability of retrospective self-report. Tanoffsky Kraff et al. (2007) recommended measuring emotional eating in a domain specific way to improve the predictive potential of emotional eating scores. The provision of specific exemplars of the target experience has been found to produce a more valid assessment and enhance accuracy of recall of health behaviours in self-report measures (e.g., Brauner-Otto et al., 2012). This has been applied to the measurement of food craving (e.g., Nicholls and Hulbert-Williams, 2013), and may offer one method of improving the concordance between self-reported emotional eating and eating behaviour.

The means of inducing emotion presents a methodological consideration for experimental studies. Included experimental studies utilized a range of methods for stress induction including the TSST (e.g., Van Strien et al., 2014), unsolvable anagrams (e.g., Royal and Kurtz, 2010), idiosyncratic recall of a stress event (e.g., Schneider et al., 2010), and data collection over exam periods (e.g., Costerelli and Patsai, 2012). Whilst all studies undertook manipulation checks to establish stress was induced, the ecological validity of methods approaches such as the TSST and unsolvable anagrams are questionable, and may be subject to experimenter effects (Faith et al., 1998). Further, idiosyncratic recall techniques produced inconsistent findings (Evers et al., 2013; Hilbert et al., 2011; Schneider et al., 2010), leading to questions regarding the reliability of this method. Such approaches are unlikely to replicate the intensity of felt emotions associated with meaningful, real-life, real-time events (e.g., exams, illness, job loss) (Berrios et al., 2015).

The need to measure actual eating behaviour in addition to measures of ‘desire to eat’, ‘food wanting’ or ‘food liking’ was highlighted by Dweck et al. (2014). They found that whilst there were no significant differences between hunger, desire to eat, and estimated quantity of food that could be eaten between stress and control conditions, actual food

consumption did vary, with those in the stress condition, who were prone to emotional eating, consuming more. Where actual food intake cannot be measured, food 'wanting' appears to be a strong determinant of actual intake during induced stress (Lemmens et al., 2011). Thus suggesting that 'wanting' in the absence of hunger, might be an important process in the development of obesity.

Together, the lack of concordance between self-report and actual behaviour, and the limited means of inducing emotions, point to the need for real time self-monitoring of thoughts, emotions and behaviour, as offered by ecological momentary assessment (Shiffman, 2009). As technology develops, this methodology is becoming more practical, and offers an ecologically valid way of assessing emotion and eating behaviour as it occurs in daily life (Polak at al., 2015).

When considering the implications of included studies for intervention development and delivery, emotional eating may be a crucial target for interventions among those who use food as a coping strategy (Wallis and Hetherington, 2009). It is suggested that such individuals consider interventions such as: stress prevention or cognitive reappraisal of stressful situations (Hilbert et al., 2011), developing adaptive coping strategies (Kelly et al., 2014), consciously accessing healthier snack foods (Wallis and Hetherington, 2009), repeating positive self-affirmations to enhance self-worth (Chao et al., 2012), or addressing cognitive restraint via 'enhanced' cognitive behaviour therapy (CBT-E) (Fairburn et al., 2009).

Individual differences highlighted within this review point to further considerations for intervention development. For example, those with a higher dietary restraint score experience more desire to eat when asked to accept or suppress emotions (Svaldi et al., 2012). As such, illustrative advice that could be offered to individuals high in dietary restraint is to minimise access to 'temptation foods' when experiencing stress (Wansink, 2004). Sleep

quality also warrants attention. A combination of sleep deprivation and proneness to emotional eating was associated with increased food consumption (Dweck et al., 2014). Short sleep is recognised to increase hunger and appetite, through the effect it has on leptin and ghrelin (Spiegel et al., 2004), and sleep deprivation itself may act as an additional stressor (St Onge and Schecter, 2014). Thus poor sleep has potential to undermine or ameliorate the effects of any intervention. Conversely, it is possible that adopting a good sleep pattern presents an intervention component that may amplify the effect of other interventions (Marks and Landaira, 2015).

The present review highlights a research focus on negative emotions and eating behaviours with an identified need to capture and differentiate between effects of discrete positive and negative emotions to better understand associations between emotions and eating behaviours (Tchanturia et al., 2015). The role of moderators and methodological considerations in accounting for equivocality of research findings is illustrated. Moderators, including dietary restraint and emotional eating, point to a need to take self-regulatory behaviours into account when exploring emotion and eating associations (Sproesser et al., 2011). Indeed, Sproesser et al. (2011) recommended that interventions should focus on the general capacity for self-control as well as a capacity for body weight control. In accordance with the strength model of self-control (Baumeister et al., 2007), continuously engaging in self-regulatory acts (such as refraining from eating or regulating one's emotion states) is effortful and depletes a limited resource (Muraven and Baumeister, 2000). Thus, emotions or eating behaviours that require self-regulation could lead to resource depletion and a decrease in ability to self-regulate at a later point (Vohs and Heatherton, 2000). Theories of self-control hold promise in framing future investigations of emotion and eating behaviour associations.

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