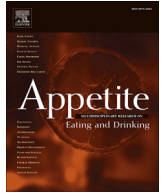




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Exploring food reward and calorie intake in self-perceived food addicts

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ABSTRACT

Previous research indicates that many people perceive themselves to be addicted to food. These 'self-perceived food addicts' may demonstrate aberrant eating patterns which put them at greater risk of overeating. However this is yet to be empirically investigated. The current study investigated whether self-perceived food addicts would exhibit higher food reward and calorie intake in a laboratory context relative to self-perceived non-addicts. A secondary aim was to investigate whether self-perceived food addicts would demonstrate increased food liking and/or increased hunger ratings. Finally, we explored whether self-perceived food addicts demonstrate patterns of aberrant eating, beyond that predicted by measures of trait dietary disinhibition and restraint. Female participants (self-perceived food addicts $n = 31$, non-addicts $n = 29$) completed measures of hunger, food reward (desire-to-eat, willingness-to-pay ratings, and an operant response task) and liking for high- and low-fat foods. Participants completed all measures when they were hungry, and again when they were satiated after consuming a fixed-lunch meal. Finally, participants were provided with *ad-libitum* access to high-and low-fat foods. Results indicated that self-perceived food addicts consumed more calories from high-fat food compared to non-addicts, despite the absence of any between-group differences in hunger or overall liking ratings. Self-perceived food addicts also displayed higher desire-to-eat ratings across foods compared to non-addicts, but groups did not differ on other measures of food reward. However, the differences in calorie intake and desire-to-eat between self-perceived food addicts and non-addicts were no longer significant after controlling for dietary disinhibition and restraint. These findings suggest that self-perceived food addicts experience food as more rewarding and have a tendency to overeat. However, this may be attributable to increased dietary disinhibition and decreased restraint rather than reflecting a unique pattern of aberrant eating behaviour.

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1. Introduction

The idea that certain foods have addictive properties similar to drugs of abuse is widely debated within the scientific community. While similarities have been identified between the neuro-behavioural effects of drugs and palatable food (e.g. Davis et al., 2011; Gearhardt et al., 2011), the extent to which excessive food intake is analogous to a substance abuse model remains a point of contention (Hebebrand et al., 2014; Ziauddeen, Farooqi, & Fletcher, 2012). Despite this, support for the concept of food addiction appears to be strong amongst members of the lay public (Lee et al.,

2013; Ruddock, Dickson, Field, & Hardman, 2015). In a recent study, 86% of Australians and Americans believed that certain foods are 'addictive', and 72% believed that food addiction causes some cases of obesity (Lee et al., 2013). Furthermore, between 28% and 52% of people from community samples believe that they are 'addicted' to food (Hardman et al., 2015; Meadows & Higgs, 2013; Ruddock et al., 2015), indicating that self-perceived food addiction is prevalent within the general population.

To date, we know very little about the characteristics of people who *perceive* themselves to be 'food addicts'. To address this, in a previous qualitative study, we identified several core behaviours which characterise self-perceived food addicts (Ruddock et al., 2015). These included a tendency to eat for reward, rather than physiological hunger, frequent food cravings, diminished self-control around food, a particular problem controlling consumption of foods high in fat, and a preoccupation with food and eating.

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Our study also suggested differences between self-perceived food addiction and the clinical definition of food addiction used by the Yale Food Addiction Scale (YFAS) (Gearhardt, Corbin, & Brownell, 2009), which is based upon the Diagnostic Statistical Manual IV (DSM-IV) criteria for substance dependence. Specifically, contrary to the YFAS definition, self-perceived food addiction was not thought to be characterised by 'significant distress' or an 'impairment to daily functioning'. Consistent with this, other studies indicate that the majority of self-perceived food addicts do not meet the YFAS diagnostic criteria for food addiction (Hardman et al., 2015; Meadows & Higgs, 2013).

Despite not necessarily fulfilling an established criterion for food addiction (i.e. the YFAS), there is evidence to suggest that self-perceived food addicts have problematic patterns of eating and may be at risk of overeating. Specifically, a previous study found that self-perceived food addicts scored significantly higher on measures of pathological eating compared to self-perceived non-addicts (Meadows & Higgs, 2013). Furthermore, a number of laboratory studies have shown increased desire for and greater intake of chocolate in self-diagnosed chocolate addicts compared to non-addicts (Hetherington & Macdiarmid, 1995; Macdiarmid & Hetherington, 1995; Tuomisto et al., 1999).

Building on these preliminary findings, the aim of the current study was to examine the behavioural characteristics of individuals who perceive themselves to be 'food addicts'. Specifically (and following on from Hetherington & Macdiarmid, 1995; Macdiarmid & Hetherington, 1995; Tuomisto et al., 1999), we sought to determine whether self-perceived food addicts would exhibit higher food reward and calorie intake in a laboratory context relative to non-addicts. We employed the following three measures as proxy indicators of food reward – 1) desire-to-eat ratings for a portion of food, 2) by asking participants to indicate how much money they would be willing to pay for a portion of food, and 3) an operant response task in which participants repeatedly tapped a computer key, within a 1 min time period, in exchange for larger portions of food. These measures have been validated by Rogers and Hardman (2015) and used in previous studies on food reward (Brunstrom & Rogers, 2009; Hardman, Herbert, Brunstrom, Munafò, & Rogers, 2012). Previous studies indicate that individual differences in food reward are most apparent when participants are satiated relative to in a hungry state (Castellanos et al., 2009; Dalton, Blundell, & Finlayson, 2013; Nasser, Evans, Geliebter, Pi-Sunyer, & Foltin, 2008). We therefore assessed participants in both hungry and satiated states and we expected to see a greater difference between self-perceived addicts and non-addicts in the latter state. We also expected self-perceived food addicts to find high-fat foods more rewarding relative to low-fat foods and to consume more of these foods *ad-libitum*, compared to non-addicts. This is consistent with our previous findings in which self-perceived food addicts reported a tendency to overeat high-fat foods (Ruddock et al., 2015). Similarly, another study found that high-fat foods, such as chocolate and crisps, were regarded as more 'addictive' than low-fat foods, such as fruit and plain crackers (Schulte, Avena, & Gearhardt, 2015).

A secondary aim of our study was to investigate whether self-perceived food addicts would demonstrate increased food liking and/or increased hunger ratings. Hunger and food liking are thought to represent measurable components of food reward (Berridge, Ho, Richard, & DiFeliceantonio, 2010; Rogers & Hardman, 2015), and so we may find that either, or both, of these are increased in those with heightened food reward. However, previous research has yielded inconsistent findings regarding this. In one study, self-diagnosed 'chocolate addicts' had increased levels of food reward (i.e. desire to eat) but did not differ from controls on measures of hunger and liking for chocolate, prior to chocolate

consumption (Hetherington & Macdiarmid, 1995). In contrast, increased chocolate liking has been observed in self-reported 'chocolate cravers' (Gibson & Desmond, 1999), and Finlayson, Arlotti, Dalton, King, and Blundell (2011) demonstrated increased hunger perceptions in those with a propensity to overeat.

A further secondary aim was to establish the extent to which self-perceived food addicts demonstrate patterns of aberrant eating behaviour that are distinct from those captured by existing measures of dietary disinhibition (i.e. loss of control over intake) and restraint (i.e. attempts to restrict intake). This is important as food addiction is considered to be a distinct clinical condition, which nonetheless overlaps with other forms of pathological eating such as binge eating (Davis, 2016). It is therefore necessary to establish the extent to which the concept of food addiction *uniquely* predicts patterns of overeating (Long, Blundell, & Finlayson, 2015). To address this, we explored the extent to which self-perceived food addiction predicts increases in food reward and calorie intake over and above that accounted for by high dietary disinhibition and low restraint. Dietary disinhibition was measured using the Binge Eating Scale (Gormally, Black, Daston, & Rardin, 1982) and the disinhibition subscale of the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), both of which are thought to reflect differing degrees of 'uncontrolled' or disinhibited eating (Vainik, Neseliler, Konstabel, Fellows, & Dagher, 2015). Dietary restraint was assessed using the restraint subscale of the TFEQ which assesses successful restraint (Heatherton, Herman, Polivy, King, & McGree, 1988) and, accordingly, in our study we considered low dietary restraint as a risk factor for overeating (Rollins, Loken, & Birch, 2011). These measures demonstrate good predictive validity for *ad-libitum* food intake, eating psychopathology, and the tendency to engage in uncontrolled eating (Duarte, Pinto-Gouveia, & Ferreira, 2015; Ouwens, van Strien, & van der Staak, 2003; Rollins et al., 2011).

To summarize, the aims of the current study were as follows; (1) To investigate whether self-perceived food addicts would demonstrate increased food reward (most notably when satiated), and would subsequently consume more calories when given *ad-libitum* access to high- and low-fat foods compared to non-addicts. In particular, these differences were expected to be most pronounced towards the high-fat foods. (2) To test the hypothesis that increased food reward in self-perceived food addicts would be accounted for by increased liking for the test foods, and/or increased hunger, (3) To explore the extent to which self-perceived food addiction predicts increased food reward and calorie intake over and above existing measures of binge eating, dietary disinhibition and restraint.

2. Method

2.1. Participants

Participants ($N = 64$) were recruited from the University of Liverpool via poster and online advertisements. As this was a preliminary study into self-perceived food addiction, we restricted the sample to females in order to minimize between-subject differences as a result of gender. Participants were purposefully recruited such that approximately half were self-perceived food addicts. To achieve this, after approximately 30 self-perceived non-addicts had been recruited, we restricted recruitment to self-perceived food addicts *only*. This was specified in the inclusion criteria displayed on study advertisement posters, and on the participant information sheet. Self-perceived food addiction was assessed using a self-report measure (see Measures section for details). Participants were excluded from the study if they had any food allergies or intolerances, had ever been diagnosed with an eating disorder, were

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