



## Research report

# A cross-sectional investigation of trait disinhibition and its association with mindfulness and impulsivity

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## ABSTRACT

Two online surveys were conducted to assess the relationship between trait disinhibition, impulsivity, mindfulness and adverse psychological symptoms. In study 1 adult females ( $n = 196$ ; mean age = 21 yrs) completed the Three-Factor Eating Questionnaire (TEFQ-R21), the Hospital Anxiety and Depression Scale and a measure of dispositional mindfulness. In study 2 adult females ( $n = 190$ ; mean age = 26 yrs) completed the same measures as in study 1 with the addition of the Barratt Impulsivity Scale. In both studies it was predicted that mindfulness would be negatively related to trait disinhibition controlling for adverse psychological symptoms. The second study addressed the additional hypothesis that the relationship between mindfulness and trait disinhibition would be mediated by impulsivity. Regression analyses indicated that mindfulness was negatively related to and explained 11% of variation in trait disinhibition (study 1). This relationship was replicated and extended in study 2 whereby impulsivity mediated the relationship between mindfulness and trait disinhibition. The findings warrant experimental and *in vivo* investigations of the potential causal relationships between mindfulness, impulsivity and eating behaviours.

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## Introduction

Trait disinhibition is a propensity to be over responsive to external food cues and to eat in response to negative affect. Due to its association with overeating it is considered a behavioural proxy for body weight variation (Bryant, King, & Blundell, 2007; Dykes, Brunner, Martikainen, & Wardle, 2004; Hays et al., 2002). Trait disinhibition also reflects a “tonic readiness to eat” thereby conferring an “enduring and constant vulnerability to be stimulated to eat” (Blundell et al., 2005, p. 621). This is reflected by research highlighting its association with binge eating and dietary relapse (Bryant et al., 2007), and its ability to predict weight regain following weight loss (Cuntz, Leibbrand, Ehrig, Shaw, & Fichter, 2001). This evidence indicates that trait disinhibition is characteristic of a susceptibility to gain weight. Therefore, if the behavioural aspects of trait disinhibition could be modified, this would potentially curb the impact of the trait on eating behaviour and by consequence body weight.

Bryant et al. (2007) have reviewed physiological and psychological factors associated with trait disinhibition and conclude that it plays a “significant mediating role between the ‘person’ and the ‘environment’ . . .” (p. 416). Further evidence is required to identify

the nature of psychological factors that mediate the behavioural expression of the trait. Empirical evidence highlights a positive relation between trait disinhibition and impulsivity (Yeomans, Leitch, & Mobini, 2008) and a negative relation between dispositional mindfulness and impulsivity (Brown & Ryan, 2003). The current investigation examined how mindfulness and impulsivity are associated with trait disinhibition.

Trait disinhibition as measured by the Three-Factor Eating Questionnaire (Cappelleri et al., 2009; Karlsson, Persson, Sjöström, & Sullivan, 2000; Stunkard & Messick, 1985) characterises an habitual behavioural tendency to respond to the hedonic properties of food (Barkeling, King, Naslund, & Blundell, 2007). This notion is supported by evidence that obese individuals who exhibit high trait disinhibition report no relationship between hunger sensation and eating (Barkeling et al., 2007). Furthermore, obese individuals have been shown to have a weak satiety response to fatty meals, a strong preference for high-fat foods when sated and a strong hedonic attraction to palatable foods (Blundell et al., 2005). The apparent habitual responding associated with trait disinhibition is likely to be activated automatically by specific environmental cues. In general, automatic processes occur without intention or awareness and are difficult to terminate once initiated. In contrast, controlled processes can be initiated and terminated at will and people are usually aware of their action (Bargh, 1997). Self-awareness is important in determining whether an implicit motivation is expressed behaviourally and is central to effective

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self-regulation of motivation (Carver & Scheier, 1981; Deci & Ryan, 1980), specifically the self-regulation of eating behaviour (Baumeister, Heatherton, & Tice, 1994; Heatherton & Baumeister, 1991; Lattimore & Maxwell, 2004).

Awareness directed at psychological and behavioural processes is likely to serve a “de-automatization” function (Bargh, 1997) and therefore facilitate self-regulation. In this respect, the likelihood of habitual behaviour being expressed will depend to some extent upon how aware an individual is of his or her habitual responding and the external or internal cues that drive it. The behavioural expression of trait disinhibition could be characterised as an automatic response driven by cues which the individual may not always be aware, or in control of. This proposition is supported by evidence for an association between the trait disinhibition and personality dispositions such as impulsiveness.

Specific personality dispositions are associated with disinhibition as measured by the TFEQ-51. Research provides evidence for positive associations with novelty seeking and negative associations with self-directedness – an ability to resist external cues (Gendall, Joyce, Sullivan, & Bulik, 1998). In addition the Barratt Impulsivity Scale (BIS-11) (Patton, Stanford, & Barratt, 1995), and behavioural measures of impulsivity (i.e., delayed discounting task) are positively associated with the TFEQ-51 disinhibition scale. The BIS-11 comprises three second order factors: motor impulsiveness, defined as acting without thinking; non-planning impulsiveness (a lack of forethought), and attentional impulsiveness (an inability to focus attention (Barratt, 1985; Patton et al., 1995)). Women with higher scores on the TFEQ-51 disinhibition scale score higher on the BIS-11 total score, motor impulsiveness and non-planning factors (Yeomans et al., 2008). Additionally, women with higher scores on the TFEQ-51 disinhibition scale are more impulsive based on their delayed discounting task performance (Yeomans et al., 2008). This association is independent of level of cognitive restraint which has been widely considered as a predictor of overeating (Polivy, Herman, & Coelho, 2008). These findings are supported by experimental evidence showing that normal weight highly impulsive women eat more in laboratory taste tests compared to their low-impulsive counterparts (Guerrieri et al., 2007) and that impulsivity is a better predictor of relative overeating than cognitive restraint (Jansen et al., 2009).

Jansen's research group have advanced our understanding of the relationship between impulsivity and eating by highlighting how impulsivity may be a more important predictor of overeating, and by consequence overweight, than cognitive restraint. In light of these developments and conceptual associations, investigations into the relationship between impulsivity and trait disinhibition are clearly warranted. The theoretical case for investigation is based on an evolutionary account of overweight in modern society (van den Bos & de Ridder, 2006) which is conceptually aligned with the thrifty genotype hypothesis (for discussion see Bryant et al., 2007). A full account of the evolutionary perspective is beyond the scope of this paper (see review in van den Bos & de Ridder, 2006). Central to the evolutionary account of being overweight is the question of the role of self-control under conditions of certainty and uncertainty in the food environment. A tendency to gratify immediate needs by eating more than is nutritionally required, especially when future food supply is uncertain, would have been potentially adaptive, whereas patience or waiting for better foods would have had limited adaptive benefit. Immediate gratification equates to impulsiveness and delayed gratification equates to self-control (Forzano & Corry, 1998); humans, like animals demonstrate difficulty maintaining self-control especially when the reward value of food is high (Stephens, Kerr, & Fernandez-Juricic, 2004). The foregoing theoretical perspective suggests that in the current environment where humans are exposed to a large variety of foods differing in reward value they will be susceptible to

immediate gratification, and by consequence gain weight, due to inherent traits, such as disinhibition and impulsiveness, that historically may have had adaptive benefit. In this respect consideration of the nature of impulsiveness may shed light on how impulsive behaviour could be moderated.

The conceptualisation of impulsivity advanced by Barratt has had considerable influence in a range of domains (see Stanford et al., 2009 for review) and arguably impulsivity represents a disposition to act without awareness. Indeed this notion is implicit in a widespread definition: “[impulsivity is] a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individuals or to others” (Stanford et al., 2009, p. 385). We would suggest that if ‘acting without awareness’, as a manifestation of impulsivity, is positively associated with trait disinhibition we should expect that its polar opposite, ‘acting with awareness’, is negatively associated with the same trait. Acting with awareness is a core component of dispositional mindfulness. As various techniques have been put forward to foster mindfulness (Levesque & Brown, 2007), it will be of interest to investigate the potential links between dispositional mindfulness, impulsivity and trait disinhibition. If a tendency to be mindful reduces the likelihood of acting impulsively it would be expected that in turn that acting mindfully would reduce the likelihood of responding automatically to external and internal cues to eat.

Mindfulness is distinct from other forms of dispositional awareness that facilitate self-regulation, as for instance cognitive activity that focuses on the self (Heatherton & Baumeister, 1991), private and public self-awareness (Heatherton, Polivy, Herman, & Baumeister, 1993) and reflection (Trapnell & Campbell, 1999). In contrast to these forms of ‘reflexive awareness’, mindfulness has been described as ‘pre-reflexive’ awareness (Levesque & Brown, 2007) that is characterised by receptive attention to and awareness of present events and experiences (Brown, Ryan, & Creswell, 2007). Mindfulness does not involve evaluation, contemplation, introspection, reflection or rumination. Instead it is characterised by awareness of thoughts, impulses, physical sensations etc., and their accompanying emotions as simply reactions to them, where the mind can be engaged and disengaged by choice (Chambers, Gullone, & Allen, 2009). While reflexive awareness operates *within* experiences mindfulness operates *upon* them. Accordingly, mindfulness has been proposed as a means to “de-automatize” habitual responding to facilitate more effective self-regulation (Levesque & Brown, 2007) and several studies confirm a link between mindfulness and the de-automatization of cognitive functions (Cahn & Polich, 2009; Chambers, Lo, & Allen, 2008; Jha, Krompinger, & Baime, 2007; Lutz, Slagter, Dunne, & Davidson, 2008; Moore & Malinowski, 2009).

Mindfulness is negatively related to impulsivity, depression and anxiety (Brown & Ryan, 2003) and there has been a proliferation of research into its nature and potential use in therapeutic interventions (Brown et al., 2007). Investigation of the nature of mindfulness is clearly positioned in the context of habitual and automatic processes (Levesque & Brown, 2007) whereas its potential as a therapeutic tool has been addressed in varied contexts (Allen, Blashki, & Gullone, 2006), for example: stress reduction and depression (Chiesa & Serretti, 2009; Teasdale et al., 2002), eating disorders (Kristeller, 2007; Nagata, 2009), and weight control (Barnes, Kristeller, Shenbagarajan, Stevens, & Johnson, 2008; Davis, Jakicic, Otto, & Spadaro, 2008; Tapper et al., 2009). Recently a mindfulness based intervention addressed food craving in people attempting weight loss (Alberts, Mulken, Smeets, & Thewissen, 2010) using meditation techniques common to many mindfulness based interventions (Kristeller, 2007). Participants were taught how to use meditation exercises to facilitate awareness of thoughts and bodily sensations related to

cravings without judging or identifying with the content of such thoughts. The intervention equipped participants to resist cravings by simply focusing on and accepting sensations and thoughts that accompany the urges to eat. This enabled increased awareness of the “automatic pattern that usually emerges in the case of food cravings” (Alberts et al., 2010, p. 161). The authors maintain that the use of such mindful mediation exercises resulted in a reduction in cravings in response to food cues and a reduction in the extent to which participants experienced loss of control when exposed to food cues.

Although the concept of mindfulness has attracted increased attention in the intervention literature the mechanisms by which enhanced mindfulness influences outcomes in a range of domains has yet to be clearly identified (Malinowski, 2008). Initial evidence supports the notion that mindfulness serves a “de-automatization” function or an “undoing” of automatic habitual processes whereby mindfulness modulates a motivational tendency toward heteronomy (Levesque & Brown, 2007). In effect, mindfulness leads to ‘acting with awareness’. Although enhancement of dispositional mindfulness has been addressed in the eating disorder therapy literature there has, with the exception of Alberts et al. (2010), been no assessment of its relationship with measures that capture behavioural tendencies to overeat. This is an important issue to address because of the putative inverse relationship between mindfulness and impulsivity and the positive relationship between impulsivity and trait disinhibition. Indeed this proposition partly addresses the suggestion put forward by Jansen et al. (2009) to “study ways that promote inhibition or self-control in otherwise impulsive people” (p. 109).

The aim of the current investigation was firstly to determine how dispositional mindfulness is related to trait disinhibition, and secondly, examine how impulsivity would influence the relationship between mindfulness and trait disinhibition. The revised version of the original TFEQ-51 (Cappelleri et al., 2009; Karlsson et al., 2000) was used to assess disinhibition. The TFEQ-R21 includes two subscales, in addition to a cognitive restraint scale, that assess different components of trait disinhibition. Firstly, uncontrolled eating (TFEQ-UE) which combines items from the original hunger and disinhibition scales reflects a propensity to overeat in response to external food related stimuli. Secondly, emotional eating (TFEQ-EE) which comprises items solely from the original disinhibition scale reflects a propensity to overeat in response to negative emotional states. Trait disinhibition is associated with adverse psychological symptoms such as depression (Kensinger, Murtaugh, Reichmann, & Tangney, 1998; Provencher et al., 2007) and anxiety (Karlsson et al., 2000). Therefore, we included assessment of such symptoms to statistically control for their influence. Initially (study 1) we predicted that mindfulness would be negatively associated with trait disinhibition, that is, greater dispositional mindfulness would be associated with lower scores on the TFEQ-R21 uncontrolled and emotional eating scales after controlling for an association with adverse psychological symptoms. Subsequently (study 2) we re-tested the same hypotheses in a new sample where we also measured impulsivity using the BIS-11. We predicted that mindfulness would be inversely related to impulsivity and components of trait disinhibition, and that impulsivity would be positively associated with components of trait disinhibition after controlling for adverse psychological symptoms.

## Study 1

### Methods

#### Participants

One hundred and ninety-six female psychology undergraduates were recruited opportunistically to complete questionnaires

online in exchange for course credit. Participants ranged in age from 18 to 56 years ( $M = 21$ ;  $SD = 5.5$ ). The mean body mass index (BMI) of the sample was  $23 \text{ kg/m}^2$  ( $SD = 3.8$ ; range  $17\text{--}38 \text{ kg/m}^2$ ). BMI was calculated from self-reported weight and height.

### Materials

Trait disinhibition was assessed using the 21-item revised Three-Factor Eating Questionnaire (TFEQ-R21) (Karlsson et al., 2000) a more psychometrically robust version of the original 51-item Three-Factor Eating Questionnaire (Stunkard & Messick, 1985). At the time of study the TFEQ-R18V2 was not available (Cappelleri et al., 2009) although that revision only involved adjustment to the cognitive restraint scale. The TFEQ-R21 comprises three scales that assess cognitive restraint (tendency to control food intake in order to influence body weight and shape) uncontrolled eating (tendency to lose control over eating when feeling hungry or when exposed to food stimuli) and emotional eating (propensity to overeat in response to negative mood states). The TFEQ-R21 response format comprises 20 four-point scales (definitely true/mostly true/mostly false/definitely false) and one eight point scale. Scores are summed to produce scale scores and the raw scores are transformed to a 0–100 scale. Higher scores are indicative of greater cognitive restraint, uncontrolled or emotional eating. The TFEQ-R21 has acceptable internal consistency and criterion and discriminant validity (Karlsson et al., 2000). In the current sample the TFEQ-R21 cognitive restraint, uncontrolled eating and emotional eating subscales had acceptable internal consistency (Cronbach  $\alpha = 0.83$ ,  $0.83$  and  $0.89$  respectively).

Dispositional mindfulness was assessed using a short-form (Malinowski, unpublished) of the Kentucky Inventory of Mindfulness Skills (KIMS) (Baer, Smith, & Allen, 2004). The short-form KIMS comprises 21 items that measure three aspects of mindfulness skills: (1) *accept or allow without judgement* (KIMS-AJ) refers to being non-judgemental about present moment experience or allowing reality to be as it is without attempting to avoid, escape or change it; (2) *observing* (KIMS-O) refers to attending to stimuli and internal sensations including bodily sensations, cognitions and emotions, and external stimuli such as sounds and smells; and (3) *acting with awareness* (KIMS-AA) refers to engagement with current activity with undivided attention rather than operating on “automatic pilot”. Items are responded to using a 5 point scale (never or very rarely true, rarely true, sometimes true, often true and very often or always true). Scores between 1 and 5 are summed to produce totals for each subscale and a total scale score. The reliability of the KIMS subscales and total scale has proven to be satisfactory in previous studies (Malinowski, unpublished). The development of the 21-item shortened version was based on the analysis of responses from 492 participants who completed an online version of the Kentucky Inventory of Mindfulness Skills (KIMS, Baer et al., 2004). For conceptual reasons the KIMS subscale “describing” was excluded and for each of the remaining three subscales seven items were maintained. These items were chosen in an iterative analysis, which included factor analyses (lowest loading items excluded), inter-item correlations, as well as analyses regarding the effect on the internal consistency if an item was excluded. A Factor analysis with Varimax rotation of the newly created scale confirmed a clear 3-factor structure, with all included items loading highly (min 0.54, max 0.84) on only one of three components “accepting without judgement”, “observing” and “acting with awareness”. Internal consistencies (Cronbach  $\alpha$ ) of the shortened scales were similar to those from the original scale (0.90 vs. 0.89; 0.73 vs. 0.83; 0.79 vs. 0.78, respectively). The use of the KIMS in the current study resulted in acceptable internal consistency (Cronbach  $\alpha$ ) for KIMS-AJ ( $\alpha = 0.91$ ), KIMS-O ( $\alpha = 0.74$ ) and KIMS-AA ( $\alpha = 0.79$ ) subscales.

Adverse psychological mood was assessed using the Hospital Anxiety and Depression Scales (HADS) (Zigmond & Snaith, 1983).

**Table 1**

Study 1 Pearson correlations, range, mean and standard deviation for TFEQ-R21 scales, mindfulness and adverse psychological symptoms.

| Variable       | Range | M    | SD   | 2      | 3     | 4       | 5       | 6       | 7       | 8       | 9       | 10      |
|----------------|-------|------|------|--------|-------|---------|---------|---------|---------|---------|---------|---------|
| 1. TFEQ-UE     | 0–100 | 45.5 | 17.4 | 0.50** | –0.01 | –0.29** | 0.19**  | –0.22** | –0.32** | 0.23**  | 0.25**  | 0.27**  |
| 2. TFEQ-EE     | 0–100 | 41.9 | 23.3 |        | –0.06 | –0.21** | 0.09    | –0.20** | –0.25** | 0.23**  | 0.21**  | 0.25**  |
| 3. TFEQ-CR     | 0–100 | 46.3 | 20.8 |        |       | –0.12   | 0.16*   | –0.02   | –0.09   | 0.07    | 0.03    | 0.06    |
| 4. KIMS-AJ     | 1–35  | 23.6 | 6.0  |        |       |         | –0.31** | 0.35**  | 0.90**  | –0.55** | –0.47** | –0.58** |
| 5. KIMS-O      | 1–35  | 19.3 | 4.3  |        |       |         |         | 0.04    | –0.21** | 0.25**  | 0.06    | 0.19**  |
| 6. KIMS-AA     | 1–35  | 18.9 | 3.9  |        |       |         |         |         | 0.73**  | –0.27** | –0.20** | –0.27** |
| 7. Mindfulness | 1–70  | 42.4 | 8.2  |        |       |         |         |         |         | –0.53** | –0.43** | –0.55** |
| 8. HADS-A      | 0–21  | 8.5  | 3.7  |        |       |         |         |         |         |         | 0.55**  | 0.91**  |
| 9. HADS-D      | 0–21  | 3.9  | 2.9  |        |       |         |         |         |         |         |         | 0.85**  |
| 10. HADS-TOTAL | 0–42  | 12.4 | 5.8  |        |       |         |         |         |         |         |         |         |

Note: TFEQ-UE = uncontrolled eating; TFEQ-EE = emotional eating; TFEQ-CR = cognitive restraint; KIMS-AJ = accept or allow without judgement; KIMS-O = observing; KIMS-AA = acting with awareness; mindfulness = sum (composite) of KIMS-AJ and KIMS-AA; HADS-A = anxiety; HADS-D = depression.

\*  $p < 0.05$ .\*\*  $p < 0.01$ .

The HADS is generally used to detect anxiety and depression in outpatients and the general population and consists of seven depression (HADS-D) and seven anxiety (HADS-A) items. The 14 items are rated on a 4-point scale ranging from the absence of symptoms (scoring zero) to maximum severity of symptoms (scoring 3). In the current sample, internal consistency was satisfactory for the HADS-TOTAL, HADS-D and HADS-A (Cronbach  $\alpha = 0.86, 0.79, 0.74$ , respectively).

#### Procedure

Ethical approval for the study was obtained from the University Ethics Committee. Questionnaires were delivered online via the School of Psychology research participant system using Sona Systems software. All variables were examined for normality of distributions prior to hypothesis testing. Except for the HADS all variables were normally distributed and contained no outliers. Three outliers were identified on the HADS total scale ( $z$ -scores  $> 2.5$ ). Given the sample size these three cases were removed prior to computation of correlation and regression coefficients (the outcome of analyses did not differ in terms of significance levels with the outlier cases included, but the magnitude of coefficients did vary if they were included).

#### Results

Pearson correlations between the TFEQ-R21, KIMS and HADS scales are displayed in Table 1. Regarding significant correlations between the TFEQ-R21 and KIMS scales, a consistent pattern is apparent. Higher scores on the uncontrolled and emotional eating scales are associated with lower scores on the KIMS accept-without-judgement and acting-with-awareness scales. Similarly, high scores on the uncontrolled and emotional eating scales are associated with higher HADS anxiety, depression and total scale scores. Lower scores on the KIMS accept-without-judgement and acting-with-awareness scales are associated with higher HADS anxiety, depression and total scale scores. It is notable that the KIMS observe scale is positively correlated with the TFEQ uncontrolled eating and cognitive restraint scales. This would suggest that greater attending to internal and external stimuli is related to a tendency to overeat in response to internal and external cues to eat, and a propensity to be a restrained eater. This apparent relationship is at odds with the associations between the other KIMS scales and components of trait disinhibition. It is also unexpected to find that the KIMS observe scale is negatively correlated with the KIMS accept-without-judgement scale. This negative relationship was also observed in the development of the original version of the KIMS (Baer et al., 2004). Dispositional mindfulness, especially when enhanced through meditative practice should lead to greater skill in observing, acting with

awareness and accepting without judgement (Moore & Malinowski, 2009). All three should operate in unison. This raises concerns about the validity of the observe scale. In light of this we opted to exclude the observe scale from computation of a composite score for the KIMS. A summative composite of the KIMS-AJ and KIMS-AA scales (Mindfulness Composite; Cronbach  $\alpha = 0.77$ ) was employed as a predictor in multiple regression analysis and is subsequently referred to as Mindfulness Composite. The Mindfulness Composite score was negatively correlated with TFEQ-UE and TFEQ-EE scales and each element of the HADS. The TFEQ-UE and TFEQ-EE scores were separately regressed onto the Mindfulness Composite controlling for adverse psychological symptoms (HADS-Total). A summary of the regression coefficients and related statistics is displayed in Table 2. The variance inflation factors for both regressions were below 1.5 indicating that there was no reason to suspect multicollinearity problems. Mindfulness as measured by the Mindfulness Composite significantly predicted TFEQ-UE after controlling for adverse psychological symptoms but it did not significantly predict TFEQ-EE eating scores.

#### Discussion

The outcome of study 1 supports the hypothesised relationship between dispositional mindfulness and trait disinhibition as significant negative correlations were observed between mindfulness (Mindfulness Composite) and components of disinhibition; uncontrolled and emotional eating. These correlations suggest that a tendency to exhibit uncontrolled and emotional eating is associated with lower dispositional mindfulness. Furthermore, when adverse symptoms were controlled in regression analysis mindfulness significantly predicted uncontrolled eating. However, this was not evident for emotional eating. Simple correlations

**Table 2**

Hierarchical regression analysis predicting uncontrolled and emotional eating controlling for adverse psychological symptoms.

|                       | B     | SE B | B       | $\Delta R^2$ | Final $\beta$ |
|-----------------------|-------|------|---------|--------------|---------------|
| TFEQ-UE as criterion  |       |      |         |              |               |
| Step 1                |       |      |         |              |               |
| HADS-total            | 0.81  | 0.21 | 0.27**  | 0.073**      | 0.14          |
| Step 2                |       |      |         |              |               |
| Mindfulness Composite | –0.51 | 0.17 | –0.24** | 0.114**      | –0.24**       |
| TFEQ-EE as criterion  |       |      |         |              |               |
| Step 1                |       |      |         |              |               |
| HADS-total            | 0.98  | 0.28 | 0.25**  | 0.061**      | 0.16          |
| Step 2                |       |      |         |              |               |
| Mindfulness Composite | –0.45 | 0.24 | –0.16   | 0.078        | –0.16         |

Note: Mindfulness Composite = sum of KIMS-AJ and KIMS-AA.

\*\*  $p < 0.01$

indicate that mindfulness (Mindfulness Composite) had a stronger relationship with uncontrolled than emotional eating ( $r = -0.35$  vs.  $-0.25$ , respectively). We can only speculate that the lack of significant prediction of TFEQ-EE in hierarchical regression is likely due to measurement error related to the use of the shortened KIMS. Additionally, the KIMS Observe scale in the current study produced some associations that were unexpected and difficult to explain. Dispositional mindfulness has been assessed in more in-depth and arguably more reliable ways, for example, by use of the recently developed Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). The FFMQ includes a measure of a facet of mindfulness described as non-reactivity to inner experiences, such as emotions, physical sensations etc. This aspect of mindfulness may be important to assess to gain a clearer understanding of how mindfulness is related to emotional eating. In this respect the influence of 'non-reactivity' and 'acting-with-awareness' are central to the proposition that mindfulness may aid de-automatization of habitual responding (Levesque & Brown, 2007). To address the potential limitation raised by the use of the shortened KIMS, especially regarding the anomalies relating to the Observe subscale, the FFMQ was used in study 2. In doing so we expected to replicate the pattern of results of the first study and demonstrate that emotional eating is associated with lower levels of trait mindfulness after controlling for adverse psychological symptoms.

Additionally, we explored the possibility that if mindfulness predicted trait disinhibition, this relationship would be mediated by impulsivity. Research indicates positive correlations between impulsivity and trait disinhibition as measured by the original TFEQ-51 (Gendall et al., 1998; Yeomans et al., 2008) and the outcome of study 1 indicates that mindfulness is negatively associated with trait disinhibition. Mindfulness has been proposed as a "tool" to modulate or modify automatic behavioural tendencies (Levesque & Brown, 2007). This proposition relates to the enhancement of dispositional mindfulness through meditative practice. In study 2 we measured dispositional mindfulness using a more psychometrically robust questionnaire. It was predicted that mindfulness would be negatively associated with impulsivity; furthermore we predicted that the association between mindfulness and trait disinhibition would partly depend upon the dual influence that impulsivity has on mindfulness and trait disinhibition.

## Study 2

### Methods

#### Participants

One hundred and ninety females (students and wider local community) were recruited opportunistically to complete questionnaires online in exchange for entry into a prize draw. Participants ranged in age from 19 to 49 years ( $26 \pm 0.6$  yrs). The mean body mass index (BMI) of the sample was  $23 \pm 0.3$  kg/m<sup>2</sup>; range 19–37 kg/m<sup>2</sup>. BMI was calculated from self-reported weight and height.

#### Materials

Trait disinhibition and adverse psychological symptoms were assessed using the TFEQ-R21 and HADS as in study 1. Internal consistency for the TFEQ-R21 scales in the current sample was satisfactory (TFEQ-CR, TFEQ-UE and TFEQ-EE; Cronbach  $\alpha = 0.80$ ,  $0.83$  and  $0.88$  respectively). Likewise, the internal consistency of the HADS scales was acceptable (HADS-TOTAL, HADS-A, HADS-D; Cronbach  $\alpha = 0.84$ ,  $0.80$ ,  $0.74$ , respectively).

Mindfulness was assessed using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006). The FFMQ was developed

through empirical analysis of available self-report measures of mindfulness. The FFMQ comprises five subscales or facets: (1) non-reactivity to inner experience (FFMQ-NR), e.g., "I watch my feelings without getting lost in them"; (2) observing (FFMQ-O; observing sensations, perceptions, thoughts, feelings), e.g., "I intentionally stay aware of my feelings"; (3) acting with awareness (FFMQ-A), e.g., "It seems I am running on automatic without much awareness of what I'm doing"; (4) describing (FFMQ-D; labelling with words), e.g., "When I have a sensation in my body, it's hard for me to describe it because I can't find the right words"; (5) non-judging of experience (FFMQ-NJ, refraining from value judgements or self-criticism) "I tend to evaluate whether my perceptions are right or wrong". The response format comprises a 5-point Likert scale (1 = never or very rarely true, rarely true, sometimes true, often true and 5 = very often or always true). Scores between 1 and 5 are summed to produce totals for each subscale and a total scale score. The FFMQ has been shown to have good internal consistency and significant relationships in the predicted directions with a variety of constructs related to mindfulness (Baer et al., 2006). In the current sample, internal consistency was satisfactory for the total scale (Cronbach  $\alpha = 0.88$ ) and the FFMQ-NR, FFMQ-O, FFMQ-A, FFMQ-D and FFMQ-NJ subscales ( $0.75$ ,  $0.80$ ,  $0.86$ ,  $0.87$  and  $0.90$  respectively).

Impulsiveness was measured using the Barratt Impulsiveness Scale (BIS-11). The BIS-11 comprises three second order factors: motor impulsiveness (BIS-M), defined as acting without thinking; Non-Planning Impulsiveness (BIS-NP), defined as a lack of forethought, and Attentional Impulsiveness (BIS-A), defined as an inability to focus attention (Barratt, 1985; Patton et al., 1995). Responses are given using a 4-point Likert scale (1 = rarely/never, occasionally, often, 4 = almost always/always) with higher scores indicating greater impulsivity. In the current sample the BIS-11 total, BIS-M, BIS-A and BIS-NP scales had acceptable internal consistency (Cronbach  $\alpha = 0.84$ ,  $0.65$ ,  $0.74$ , and  $0.72$  respectively).

### Procedure

Ethical approval for the study was obtained from the University Ethics Committee. Questionnaires were delivered and completed using QBuilder questionnaire software (<http://www.tinuvielsoftware.com/>) and SQL server space available on the university website. Data screening revealed that four cases included outliers on multiple variables and they were removed from the data set. The remaining 186 cases met requirements for correlation and regression analysis. Testing of the mediation hypotheses were performed according to the Baron and Kenny (1986) procedure. Where indirect effects were identified these were further assessed for robustness using the Sobel test and bootstrapping techniques (5000 re-samples; (Preacher & Hayes, 2004, 2008). The bootstrapping procedure involves calculation, through re-sampling, of the sampling distribution of the indirect effect to derive a confidence interval for the indirect effect. This procedure overcomes problems of asymmetry and other forms of non-normality associated with the sampling distribution of the Sobel test. The indirect effect is then assessed in terms of the derived upper and lower bounds of the 95% confidence interval and if the range does not pass through zero one can accept with confidence that the indirect effect is significantly different from zero at  $p < 0.05$ . In each set of regression analysis the criterion was either the TFEQ-UE or TFEQ-EE score, the predictor was the FFMQ-Total score, the mediator was the BIS-11 total score, and the influence of adverse psychological symptoms (HADS-TOTAL) was used as covariate.

### Results

Descriptive statistics and Pearson correlations between the TFEQ-R21, FFMQ, HADS and BIS-11 scales are displayed in Table 3.

**Table 3**

Study 2 Pearson correlations, mean and standard deviation for BMI, TFEQ-R21, mindfulness, impulsivity and adverse psychological symptom scales.

|                             | Range  | M     | SD   | 2    | 3     | 4      | 5      | 6      | 7       | 8      | 9       | 10     | 11      | 12      | 13      | 14      | 15      |
|-----------------------------|--------|-------|------|------|-------|--------|--------|--------|---------|--------|---------|--------|---------|---------|---------|---------|---------|
| 1. BMI (kg/m <sup>2</sup> ) | 19–37  | 23.4  | 3.6  | 0.08 | 0.13  | 0.24*  | −0.04  | −0.02  | −0.03   | 0.01   | −0.05   | −0.04  | 0.02    | −0.02   | 0.06    | 0.02    | 0.11    |
| 2. TFEQ-UE                  | 0–100  | 45.7  | 17.8 |      | −0.10 | 0.54** | −0.27* | 0.01   | −0.31** | −0.09  | −0.26** | −0.18* | 0.38**  | 0.35**  | 0.31**  | 0.32**  | 0.24**  |
| 3. TFEQ-CR                  | 0–100  | 43.9  | 20.1 |      |       | 0.08   | −0.06  | 0.00   | 0.00    | −0.15* | −0.05   | 0.05   | 0.01    | −0.01   | 0.15*   | −0.07   | 0.15*   |
| 4. TFEQ-EE                  | 0–100  | 41.3  | 22.9 |      |       |        | −0.30* | 0.09   | −0.31** | −0.15* | −0.34** | −0.19* | 0.27**  | 0.36**  | 0.14    | 0.19*   | 0.34**  |
| 5. FFMQ-TOT                 | 39–195 | 122.7 | 16.9 |      |       |        |        | 0.41** | 0.72**  | 0.67** | 0.62**  | 0.66** | −0.45** | −0.55** | −0.17*  | −0.40** | −0.47** |
| 6. FFMQ-O                   | 8–40   | 25.6  | 5.5  |      |       |        |        |        | 0.05    | 0.19*  | −0.17*  | 0.31*  | 0.08    | 0.11    | 0.15*   | −0.05   | 0.11    |
| 7. FFMQ-A                   | 8–40   | 24.2  | 5.4  |      |       |        |        |        |         | 0.37** | 0.45**  | 0.32** | −0.56** | −0.66** | −0.33** | −0.41** | −0.40** |
| 8. FFMQ-D                   | 8–40   | 26.6  | 5.7  |      |       |        |        |        |         |        | 0.19**  | 0.31** | −0.27** | −0.35** | −0.08   | −0.25** | −0.22** |
| 9. FFMQ-NJ                  | 8–40   | 25.2  | 6.9  |      |       |        |        |        |         |        |         | 0.25** | −0.34** | −0.44** | −0.20** | −0.25** | −0.53** |
| 10. FFMQ-NR                 | 7–35   | 21.2  | 4.2  |      |       |        |        |        |         |        |         |        | −0.26** | −0.35** | −0.04   | −0.27** | −0.35** |
| 11. BIS-TOT                 | 30–120 | 64.0  | 10.7 |      |       |        |        |        |         |        |         |        |         | 0.77**  | 0.78**  | 0.86**  | 0.23**  |
| 12. BIS-A                   | 8–32   | 16.7  | 4.0  |      |       |        |        |        |         |        |         |        |         |         | 0.46**  | 0.51**  | 0.39**  |
| 13. BIS-M                   | 11–44  | 22.6  | 4.5  |      |       |        |        |        |         |        |         |        |         |         |         | 0.50**  | 0.07    |
| 14. BIS-N                   | 11–44  | 24.7  | 5.1  |      |       |        |        |        |         |        |         |        |         |         |         |         | 0.17*   |
| 15. HADS-TOT                | 0–42   | 11.4  | 6.2  |      |       |        |        |        |         |        |         |        |         |         |         |         |         |

Note: BMI=body mass index; TFEQ-UE=uncontrolled eating; TFEQ-EE=emotional eating; TFEQ-CR=cognitive restraint; FFMQ-O=observing; FFMQ-A=acting with awareness; FFMQ-D=describing; FFMQ-NJ=non-judging; FFMQ-NR=non-reactivity to inner experience; BIS-A=attentional impulsiveness; BIS-M=motor impulsiveness; BIS-N=non-planning impulsiveness; HADS-TOT.

\*  $p < 0.05$ .  
\*\*  $p < 0.01$ .

The overall pattern of correlations observed support and extend the findings from study 1. Trait disinhibition as measured by the TFEQ-R21 is negatively related to mindfulness and positively related to impulsivity and adverse psychological symptoms. In this respect the magnitude of the correlations between the TFEQ-R21 emotional eating and FFMQ-TOTAL scores are greater than in study 1. The TFEQ-R21 uncontrolled eating subscale is correlated with each of the BIS subscales, and likewise the TFEQ-R21 emotional eating subscale, except there is a non-significant relationship with motor impulsiveness. Mindfulness is negatively related to impulsiveness: the subscale scores indicate that this negative relationship is strongest between the BIS-11 attentional impulsivity subscale and the FFMQ acting-with-awareness subscale, followed by FFMQ non-judgemental awareness, non-reactivity and describing subscales. This observation lends strong support to our proposition that impulsivity represents a disposition to act without awareness. Regarding the HADS scores, the correlations reflect the same pattern of results as in study 1: uncontrolled and emotional eating are positively related with adverse psychological symptoms. Furthermore, all but the BIS-11 motor impulsiveness scale are positively related with the HADS-TOTAL, and all FFMQ scores, except for the FFMQ observe scale, are negatively correlated with the HADS-TOTAL.

The pattern and significance of correlations meet the assumptions for mediation analysis according to Baron and Kenny (1986). To test the proposition that impulsivity mediates the relationship between mindfulness and trait disinhibition a series of hierarchical regressions were performed using SPSS macros (Preacher & Hayes, 2004). The unstandardized regression coefficients and related model statistics are displayed in Tables 4 and 5. The test of

**Table 4**

Summary of mediation analysis predicting uncontrolled eating, controlling for adverse psychological symptoms.

| Regression equations                         | B     | SE   | t       |
|--|-------|------|---------|
| 1. IV to mediator (a path)                   | −0.27 | 0.04 | 5.73*** |
| 2. Direct effects of mediator on DV (b path) | 0.52  | 0.12 | 4.12*** |
| 3. Total effect of IV on DV (c path)         | −0.21 | 0.08 | −2.61** |
| 4. Direct effect of IV on DV (c-prime path)  | −0.07 | 0.08 | 0.87    |
| 5. Partial effect of covariate on DV         | 0.37  | 0.22 | 1.69    |

Note: IV=FFMQ-total; DV=TFEQ-UE; mediator=BIS-11-total; covariate=HADS-total. Summary for DV model:  $R^2=0.17$ ,  $F(3, 182)=12.55^{***}$ . Sobel test value =  $-0.14 \pm 0.04$ ; bootstrapped 95% CI:  $-0.2332$  to  $-0.0716$ .

\*\*  $p < 0.005$ .  
\*\*\*  $p < 0.0001$ .

**Table 5**

Summary of mediation analysis predicting emotional eating, controlling for adverse psychological symptoms.

| Regression equations                         | B     | SE   | t       |
|--|-------|------|---------|
| 1. IV to mediator (a path)                   | −0.27 | 0.04 | 5.73*** |
| 2. Direct effects of mediator on DV (b path) | 0.34  | 0.16 | 2.09*   |
| 3. Total effect of IV on DV (c path)         | −0.25 | 0.10 | −2.38** |
| 4. Direct effect of IV on DV (c-prime path)  | −0.16 | 0.11 | 1.39    |
| 5. Partial effect of covariate on DV         | 0.92  | 0.28 | 3.23**  |

Note: IV=FFMQ-total; DV=TFEQ-EE; mediator=BIS-11-total; covariate=HADS-total. Summary for DV model:  $R^2=.16$ ,  $F(3, 182)=11.77^{***}$ . Sobel test value =  $-0.09 \pm 0.04$ ; bootstrapped 95% CI:  $-0.1903$  to  $-0.0129$ .

\*  $p = 0.05$ .  
\*\*  $p = 0.005$ .  
\*\*\*  $p < 0.0001$ .

mediation for uncontrolled eating indicates that the size of relationship between mindfulness and uncontrolled eating is reduced when the influence of the mediator is accounted for (c-prime path in mediation model). The Sobel test value and related bootstrapped confidence intervals indicate that the indirect effect is significant and generalizable. Although the coefficient for the indirect effect does not reduce to zero it is not significant and thus it can be concluded that the relationship between mindfulness and uncontrolled eating is partially mediated by impulsivity. The same test of mediation for emotional eating indicates that impulsivity partially mediates the relationship between mindfulness and emotional eating.

## General discussion

The purpose of the investigation was to establish whether dispositional mindfulness is related to trait disinhibition as measured by the TFEQ-R21 and how impulsivity may influence this relationship. Two online surveys assessed mindfulness, trait disinhibition, adverse psychological symptoms and impulsivity in female adults. Enhancement of dispositional mindfulness has been shown to cause a reduction in binge eating frequency in obesity (Kristeller, 2007) and shows potential to modify unhealthy eating habits related to weight control (Alberts et al., 2010; Barnes et al., 2008; Davis et al., 2008; Tapper et al., 2009). However, to date no evidence exists regarding the relationship between mindfulness and measures that capture behavioural tendencies to overeat. Evidence of this nature is essential to understand the mechanism by which mindfulness may increase the likelihood of adaptive

responding to food cues in an obesogenic environment. In this respect the current investigation has established that mindfulness is associated with trait disinhibition, a behavioural proxy for body weight variation; however the current study cannot establish whether this relationship is causal.

In a preliminary investigation (study 1) mindfulness was negatively correlated with both components of trait disinhibition; uncontrolled and emotional eating, but not cognitive restraint. When the positive association between adverse psychological symptoms and trait disinhibition was controlled mindfulness significantly explained 11% of the variance in uncontrolled eating but failed to significantly explain variance in emotional eating. Uncontrolled eating captures behavioural tendencies to be over responsive to food cues. The negative association between mindfulness and uncontrolled eating can be interpreted as indicating that greater attention to present moment experience may off-set tendencies to be over responsive to food cues in the environment. However, this association does not imply causation and requires experimental investigation.

In a second study we examined relationships between mindfulness, trait disinhibition and impulsiveness. Using a more robust measure of mindfulness, the FFMQ, a similar pattern of results to study 1 emerged. As predicted, components of mindfulness were negatively associated with trait disinhibition (uncontrolled and emotional eating scales); specifically, the acting-with-awareness, non-reactivity and non-judging subscales. Importantly, as predicted, the relationship between mindfulness and trait disinhibition was partially mediated by impulsivity. It is noteworthy that the magnitude of correlations between impulsivity and mindfulness are substantial, especially between acting-with-awareness and attentional impulsivity. The mediation analysis suggests that a causal relationship may exist between dispositional mindfulness and trait disinhibition but the strength and direction of this relationship partly depends upon how impulsive an individual is. These relations remain evident after controlling for adverse psychological symptoms. The lack of association between cognitive restraint and impulsivity and mindfulness in study 2 is notable. The lack of association does indicate that these personality dimensions are more readily related to components of trait disinhibition than cognitive restraint which is supported by evidence reviewed by Bryant et al. (2007). Thus it may prove more important for research studies to focus on behavioural tendencies to show uncontrolled and emotional eating as predictors of weight variation than has traditionally been the case with a focus on dietary restraint.

The outcome of study 2 corroborates existing evidence regarding the relationship between mindfulness and impulsivity (Brown & Ryan, 2003) and establishes new evidence of how both factors are related to trait disinhibition. In this respect the outcomes of study 2 support our proposition that impulsiveness is indicative of a disposition to act without awareness. In light of other evidence regarding the predictive influence of impulsivity on eating behaviour (Guerrieri et al., 2007; Jansen et al., 2009) and the relationship between impulsivity and trait disinhibition (Yeomans et al., 2008), the outcome of the current study has clear implications for experimental testing of the apparent causal relations observed. It is unlikely that mindfulness may alter the trait aspect of disinhibition but it is plausible that it may influence the behavioural expression of the trait. Dispositional mindfulness can be enhanced using techniques to foster present moment awareness and non-reactivity which could lead to effective self-regulation through the modulation of automatic-like behavioural tendencies (Levesque & Brown, 2007). Our findings suggest that enhanced mindfulness may provide a “buffer” against behavioural tendencies (i.e., impulsivity and trait disinhibition) that lead to overeating. It follows that because trait disinhibition is a marker

for tendencies to be over responsive to food cues it would be expected that individuals who score high on trait disinhibition would be less likely to overeat when they employ a mindful approach to in their daily lives and eating. These propositions can be readily tested using existing methodologies in appetite research (e.g., see Jansen et al., 2009).

The current study is limited in scope as only female participants were sampled and the evidence derived is based on correlations. Nonetheless, the robustness of the correlation evidence provides clues for the development of experimental models to test suggested causal relationships. Experimental models are required to inform interventions incorporating mindfulness for appetite and weight control of which there is limited evidence (Barnes et al., 2008; Davis et al., 2008; Tapper et al., 2009). Trait disinhibition is associated with binge eating and dietary relapse (Bryant et al., 2007) and predicts weight regain following weight loss (Cuntz et al., 2001). Impulsiveness predicts overeating under controlled laboratory conditions (Guerrieri et al., 2007; Jansen et al., 2009). The current study indicates how mindfulness is related to trait disinhibition and impulsiveness. Interventions for weight loss and extended support to limit weight should explicitly address these issues to optimise assessment of outcomes.

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