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Cognitive and behavioral correlates of BMI among male and female undergraduate students

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Abstract

We examine three sets of possible correlates of current body mass index (BMI): a set of measures based on cognitive biases for food-related information, the DEBQ indices, and the DASS indices. Contrary to expectations from related literature, none of the cognitive measures correlated with BMI in the whole sample or separately for males and females. For females there was a negative correlation between BMI and external eating and for males a positive correlation between BMI and both external eating and emotional eating, a finding which broadly replicates recent research with Dutch participants. Overall, cognitive paradigms have been employed very fruitfully in areas such as excessive drinking. Our results suggest caution in extending this research to eating behavior.

Keywords: emotional Stroop, attentional biases, BMI, DEBQ, DASS.

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Introduction

Recent years have seen a proliferation of research on cognitive biases related to psychopathology. In a recent review, Cox. Fadardi, and Pothos (2006) identified over 30 studies just with the emotional Stroop, in excessive drinking, smoking, and illicit drug use. Moreover, some laboratories are pursuing intensely cognitive-style interventions, which aim to utilize such cognitive biases for treatment purposes (Wiers et al., 2006).

The key result in alcohol abuse is that the degree of attentional bias (as measured by the alcohol Stroop) can approximately predict current level of drinking (cf. also Cox, Pothos & Hosier, 2007). In the present study we examine the evidence that a corresponding result might be possible in eating behavior. Although there is some preliminary evidence that this may be the case, results have been varied and not always consistent. Eating is more complex than alcohol consumption. Whilst simple measures of quantity can be used to assess drinking, eating may vary in terms of both the quantity of food eaten and its calorie content, both of which will influence feelings of satiety and weight gain. We focus on BMI (body mass index). BMI is the most widely used measure of whether a person's weight is adaptive or not. For example, the main dependent variable referenced in many weight loss interventions is BMI. Also, BMI is typically the variable examined in health implications of high weight; e.g., BMI has been linked with a wide range of health problems (e.g., increased risk of cardiovascular disease, diabetes, cancer and arthritis; Callee, Thun, & Petrelli, 1999).

Therefore, BMI is a dependent variable of high practical importance. Conversely, it has been difficult to robustly specify other variables corresponding to eating behavior. For example, Brunstrom et al. (2008) examined a measure of portion size (with the same sample as the one used presently). These researchers attempted to take into account a range of foods and control for both familiarity and liking of these foods. Nonetheless, they still identified some important practical problems with their portion size measure.

Which factors correlate with current BMI? We have included three sets of predictors (note that we employ the term 'predictor' in its statistical sense; our results cannot assess causality between BMI and these other variables). First, we used a set of cognitive predictors (emotional Stroop task, an initial orientation dot probe task, sustained attention dot probe task, a memory task, and the EAST (Extrinsic Affective Simon Task)). For each measure we looked at both 'healthy' foods as well as 'unhealthy' foods (rated as such by participants in pilot work), since a bias for healthy foods may be associated with a lower BMI. Note that in previous work of ours (Pothos et al., 2008), with the same sample as in this study, we found these measures to be mostly independent. Second, we employed the DEBQ indices (Dutch Eating Behavior Questionnaire; van Strien et al., 1986). The DEBQ indices (external eating, emotional eating, restraint) have already been supported as predictors of BMI (Braet & van Strien, 1997; van Strien, Herman & Verheijden, in press). Therefore, including the DEBQ indices will allow us to assess the predictive ability of the cognitive biases against established measures. Third, we examined the DASS indices (Depression Anxiety Stress Scales; stress, anxiety, and depression) as possible determinants of BMI. Finally, we examined the possible moderating importance of gender and

physical activity. Note that our sample was homogeneous in other respects; participants were all university students.

Previous research readily motivates the inclusion of such measures. The DEBQ measures can be straightforwardly motivated since they are in direct correspondence with factors which might be leading to maladaptive eating behavior (e.g., Francis, Stewart & Hounsell, 1997; Green & Rogers, 1993; Stewart & Samoluk, 1997). Likewise, depression, anxiety, and stress have all been linked with weight gain (cf. O'Connor et al., 2008). Accordingly, the inclusion of these variables is commensurate with associated research.

Regarding cognitive biases, preferential processing of food-related information (attentional biases) could arise from automatic associations between food and positive food expectancies (cf. Tiffany, 1990), or increased incentive salience of food stimuli (Robinson & Berridge, 1993), or increased preoccupation with food (Cox & Klinger, 2004). In all cases a link between increased consumption and corresponding attentional biases is postulated. Regarding *overeating*, Braet and Crombez (2003), for example, found that obese children showed a higher interference on the food Stroop compared to matched, non-obese children. Equally, *implicit* positive attitudes towards food could underlie increased consumption. For example, Craeynest et al. (2005; cf. Craeynest et al., 2007 and Roefs & Jansen, 2002) reported a higher implicit attitude towards food for obese children and Roefs et at. (2005) reported a converse association (anorexia nervosa patients were *less* sensitive to the palatability of foods). Finally, it is possible that attentional or implicit biases for food-related information result in more *elaborate* processing of such stimuli. If this is the case, then such information should be recalled better (cf. Craik and Lockhart's, 1972, levels of processing hypothesis for memory).

Method

Participants were 151 first year undergraduate students at Swansea University (88 females, 63 males). They had a mean age of 19 years (SD=0.78 years), were native English speakers, were not colour blind, and were living in shared student accommodation. They each received a small payment for participating in the study.

Measures of food-related attentional bias consisted of a dot probe task (MacLeod, Mathews & Tata, 1986) assessing initial orientation (500 ms) to healthy and unhealthy food words, a dot probe task assessing sustained attention (1200 ms) to healthy and unhealthy food words and a computerised emotional Stroop task employing both healthy and unhealthy food words. Memory bias was assessed using a recognition task for healthy and unhealthy food words. Positive and negative attitudes (i.e. ‘good’ versus ‘bad’) towards healthy and unhealthy foods were assessed using the EAST (De Houwer, 2003). All the cognitive measures and their scoring are described extensively in Pothos et al. (2008). The DEBQ was used to assess emotional, external and restrained eating behaviours, the DASS was used to assess stress, anxiety, and depression, and the Brief Physical Assessment Tool (Smith, Marshal & Huang, 2005) to assess physical activity. This resulted in a total of 16 predictors; 10 cognitive predictors (healthy foods, unhealthy foods for each of the five cognitive measures), 3 DEBQ predictors, and 3 DASS predictors. Weight and height (without shoes, heavy jackets or jumpers) were recorded for BMI calculations. Finally, participants’ dieting status was assessed by asking participants whether they were currently dieting to lose weight.

Results

Sixteen females and four males reported that they were currently dieting to lose weight. Since dieting may influence attentional bias (Tapper, Pothos, Fadardi & Ziori, 2008) these were excluded from the analysis. A further 3 participants (all females) had BMIs greater than 3.5sds above the mean and were also excluded. The remaining sample of 128 participants (69 females, 59 males) had BMIs of between 16.89 and 33.89 (M=22.74, SD=2.94).

Given the number of possible associations, all results with a $p>.05$ were rejected outright, results with $.01<p<.05$ were approached with caution, and only results with a $p<.01$ considered significant. Regarding the cognitive measures, there were no significant correlations with BMI, either for the whole sample (Table 1) or for males/females separately. A corresponding regression model also failed to reach significance either with all cognitive predictors concurrently added ($F(10,112)=0.71$, $p=.72$) or in a 'stepwise' mode. These results indicate, simply, that cognitive biases for food-related information do not predict BMI.

Physical exercise failed to predict BMI (for the whole sample or males/females separately; $r=.006$, $p=.95$, $r=-.051$, $p=.71$, $r=.15$, $p=.23$ respectively). The DEBQ indices failed to predict BMI in the whole sample (Table 1). However, for females there were significant correlations between BMI and external eating (-.26, $p=.034$) and for males between BMI and emotional eating (.27, $p=.041$) and restrained eating (.37, $p=.004$). The DASS indices failed to predict BMI either in the whole sample (Table 1) or for males/females separately.

Existing theory on cognitive measures relating to substance abuse in particular suggests that the different measures of cognitive bias should relate to each other. This was not the case in our data. A full examination of this issue is reported elsewhere, since it would have been too much of a digression to consider it here (Pothos et al.,

2008). Finally, even though the cognitive bias measures do not predict current BMI, it is possible that they might correlate with the aspects of eating behavior indexed in the DEBQ. Table 2 shows the results for females and males separately (there were no significant correlations when considering males and females together). Even though some of the correlations are in the anticipated direction (e.g., a higher attentional bias for healthy foods is associated with higher levels of restrained eating, in females), the large number of correlations (increasing the chance of a Type I error) and their somewhat inconsistent pattern makes us reluctant to consider them in more detail.

Discussion

Finding variables which correlate with current BMI has proved surprisingly hard. In fact, in other work of ours (Brunstrom et al., 2008) we have also found that a portion size measure for 12 different foods (controlled for both familiarity and liking) was generally a poor predictor of BMI. It is possible that population-wise predictors of current BMI may fail and that a composite approach taking into account genetic, metabolic, physiological, and psychological factors may be more appropriate. Note that these null results do not preclude the possibility that cognitive biases (or any of the other predictors) might predict *future* changes in BMI. Indeed, a relationship between cognitive biases for food-related information and future changes in BMI would make more sense (in terms of corresponding theory) compared to a relationship involving current BMI.

In assessing our null results, one needs to consider our population sample limitations. We employed a sample of university undergraduates whose mean age was 19 years. Although we took care to ensure that none of our participants were living with their families, it may be the case that a different pattern of results would have

been obtained with a sample involving participants recruited from the local community. Note that cognitive biases for food-related information have been identified with clinical samples (for example, Braet & Crombez, 2003, found a food Stroop bias with obese children, Roefs et al., 2005, a reverse bias for food using an implicit association measure for patients with anorexia nervosa, and Craeynest et al., 2005, a bias for food also using an implicit association measure). Another limitation relates to the way the stimuli for the cognitive measures were selected. We tried to include several foods which would generally be desirable, and so preferentially attended to, such as cake, chips, and pizza. However, average desirability for these stimuli in our particular sample may have been low. It is hard to address this problem, unless stimuli are specifically chosen for each participant.

Consistent with previous research, DEBQ indices predicted BMI. Also, interestingly, there were very different patterns of results for males and females. For the former, a higher index of emotional eating was associated with a higher BMI and likewise for restrained eating. Both these findings have been reported in previous research (van Strien et al., in press). For females, a *lower* index of external eating was associated with a higher BMI. This is consistent with recent research indicating a null or negative relationship between BMI and external eating, that may reflect the fact that external eating is characteristic of the general population rather than being specific to overweight individuals (see van Strien et al., in press).

Overall, cognitive paradigms have been extensively employed in psychopathology in recent years. Our results inform their application in eating behavior. The main conclusion is that an expectation of a straightforward association between BMI and cognitive bias for food-related information is simply wrong.

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Table 1. Correlations between BMI and cognitive, DEBQ, and DASS predictors.

Predictor	Correlation (*r*)	*p*-value
Dot probe, initial, healthy	.10	.27
Dot probe, initial, unhealthy	-.08	.35
Dot probe, healthy, sustained	.08	.39
Dot probe, unhealthy, sustained	-.12	.18
Stroop healthy	.07	.47
Stroop unhealthy	.09	.34
EAST healthy	-.09	.34
EAST unhealthy	.09	.33
Memory healthy	.03	.70
Memory unhealthy	-.03	.75
DEBQ emotional	.09	.30
DEBQ external	-.10	.25
DEBQ restrained	.15	.10
DASS stress	.11	.21
DASS anxiety	.13	.15
DASS depression	.10	.29

Table 2. The correlations between cognitive measures and DEBQ indices.

Females

Cognitive measure	Emotional	External	Restraint
Dot probe, initial, healthy	.24	.14	.28*
Dot probe, initial, unhealthy	.10	-.16	.01
Dot probe, healthy, sustained	.00	.10	-.03
Dot probe, unhealthy, sustained	.08	.21	-.05
Stroop healthy	.10	.00	.28*
Stroop unhealthy	.02	-.16	.14
EAST healthy	-.13	.03	-.10
EAST unhealthy	.13	.12	-.07
Memory healthy	-.09	-.04	.12
Memory unhealthy	-.05	-.03	-.08

Males

Cognitive measure	Emotional	External	Restraint
Dot probe, initial, healthy	-.05	-.20	.15
Dot probe, initial, unhealthy	-.19	-.09	.19
Dot probe, healthy, sustained	.08	.17	.07
Dot probe, unhealthy, sustained	-.12	.00	.15
Stroop healthy	.12	.05	.07
Stroop unhealthy	-.02	-.13	-.01
EAST healthy	-.05	.20	-.01
EAST unhealthy	-.08	.10	.32*
Memory healthy	-.01	-.03	.07
Memory unhealthy	-.29*	-.14	.04

Note: A '*' indexes a p-value which is in the range $0.01<p<0.05$; there were no correlations for which $p<0.01$.