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Sensitivity to reward and punishment: Associations with diet, alcohol consumption, and smoking

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ABSTRACT

This study examined whether sensitivity to reward predicts a range of potentially health-damaging behaviours. Secondary objectives were to explore the relationship between these behaviours and sensitivity to punishment. Sensitivity to reward and punishment were assessed among 184 individuals using questionnaire measures of Behavioural Approach System (BAS) and Behavioural Inhibition System (BIS) sensitivity. Participants also completed a food frequency questionnaire and measures of alcohol consumption and smoking. Higher BAS sensitivity predicted higher fat intake, higher alcohol consumption, greater likelihood of binge drinking, greater likelihood of being a smoker and, amongst smokers, smoking frequency. Higher BIS sensitivity predicted lower alcohol consumption but higher sugar intake. Thus, sensitivity to reward appears to be a risk factor for lifestyle behaviours that contribute to poor health. Whilst BIS sensitivity seems to offer some protection with respect to alcohol intake, the results suggest that this does not extend to health-related behaviours, in which the negative consequences may be less immediate. Instead, BIS sensitivity predicted higher sugar intake. This is consistent with the view that BIS sensitivity leads to higher anxiety, which individuals may attempt to regulate by indulging in sugary foods.

1. Introduction

The concepts of sensitivity to reward and punishment are drawn from Gray's Reinforcement Sensitivity Theory (RST, see Corr, 2008), which postulates two independent systems that control a person's tendency to approach reward-related stimuli (Behavioural Approach System; BAS) and avoid signals related to punishment (Behavioural Inhibition System; BIS). A more active BAS results in greater sensitivity to reward; a more active BIS leads to greater sensitivity to punishment. Research has suggested that the BAS can be further sub-divided into three different types of reward sensitivity: (a) Reward Drive, relating to persistent pursuit of desired goals, (b) Fun Seeking, relating to behaviours associated with biological reinforcers not requiring planning and restraint, and (c) Reward Responsiveness, relating to positive responses to receiving or anticipating reward (Carver & White, 1994; Corr, 2008). In this research, we investigate how these systems relate to health behaviour.

1.1. Behavioural activation and health behaviours

The BAS is relevant to health because many potentially damaging behaviours, such as eating a diet high in fat and sugar, have a high reward value (Stice, Burger, & Yokum, 2013). For example, Davis and colleagues found a positive relationship between reward sensitivity and body mass index (BMI) amongst normal and overweight individuals, (albeit reversed amongst obese and morbidly obese individuals, Davis & Fox, 2008; Davis et al., 2007). There is also evidence that individuals with higher sensitivity to reward are more responsive to appetising foods and food cues (e.g., Beaver et al., 2006; Rollins, Loken, Savage, & Birch, 2014; Tapper, Pothos, & Lawrence, 2010), have a greater preference for foods high in fat and sugar and are more likely to overeat (Davis et al., 2007). However, there is little research examining how reward sensitivity relates to *actual diet*. This distinction is important, as dietary preferences do not necessarily translate into eating behaviour (Connors, Bisogni, Sobal, & Devine, 2001). A study by Voigt et al. (2009) with undergraduate students showed no relationship between reward sensitivity and diet, though their measure of diet focused on consumption of only eight high calorie foods over the previous seven days so may not have been sensitive enough to uncover any possible association.

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One goal of the present study was to offer an extended consideration of the relationship between diet and behavioural approach and inhibition systems by using a validated food frequency questionnaire (FFQ; Margetts, Cade, & Osmond, 1989) to estimate sugar and fat intake. Consistent with previous research, we expected that there would be positive correlations between BAS scores and (a) total fat intake and (b) total sugar intake. Because research suggests that the Reward Drive component of BAS most strongly predicts response to food cues (Beaver et al., 2006; Tapper et al., 2010), associations with both total BAS and Reward Drive were examined.

Smoking and alcohol consumption also represent health-damaging behaviours with high reward value (Everitt & Robbins, 2005). Studies show that higher reward sensitivity, particularly in relation to Fun Seeking, is associated with higher alcohol intake and more frequent binge drinking (Feil & Hasking, 2008; Franken & Muris, 2006; Loxton & Dawe, 2001; O'Connor, Stewart, & Watt, 2009; Voigt et al., 2009). Similarly, studies show that Fun Seeking is associated with a greater likelihood of being a smoker (O'Connor et al., 2009) and more frequent use of cigarettes, cigars or chewing tobacco (Voigt et al., 2009). However, most studies showing a relationship between Fun Seeking and alcohol use or smoking have employed undergraduates, who are not representative of the general population.

Thus, another goal of the present study was to extend previous research by employing a community sample of participants to explore the relationship between BAS and consumption of alcohol and cigarettes. It was predicted that higher levels of total BAS, and higher levels of Fun Seeking in particular, would be associated with (a) higher alcohol intake, (b), a greater likelihood of binge drinking, (c), a greater likelihood of being a smoker, and (d) (amongst smokers) smoking frequency. These predictions, together with those previously outlined in relation to saturated fat and added sugar, relate to the main hypothesis of the research – that higher levels of reward sensitivity will be associated with more health-damaging behaviours.

1.2. Behavioural inhibition and health behaviours

The relationship between sensitivity to punishment and health behaviours is less clear. Recent revisions to RST (see Corr, 2008) suggest that, instead of inhibiting behaviour, the BIS draws attention to the potential dangers of a situation and functions as a conflict resolution system. As a result, a more active BIS may lead to higher anxiety. This may, in turn, leads individuals to try to reduce anxiety by indulging in behaviours such as overeating, smoking and drinking (see Hasking, 2006). In support of this, Voigt et al. (2009) found that undergraduate students with a more active BIS reported more drug use and a worse diet. Conversely, others have suggested that a more active BIS may act as a protective factor due to avoidance of potentially risky situations or aversive consequences (e.g., hangovers). In support of this, Franken and Muris (2006) found weak negative correlations between measures of BIS and both quantity of alcohol consumed and frequency of binge drinking amongst undergraduates. Similarly, Knyazev, Slobodskaya, Kharchenko, and Wilson (2004) found that a more active BIS protected against substance abuse amongst female (but not male) youths. An additional possibility is that a more active BIS increases anxiety in response to health information, which may motivate health-related behaviours (Norman, Boer, & Seydel, 2005).

The present study conducted exploratory analyses of the relationship between BIS and health behaviours. To the extent that a more active BIS would lead individuals to indulge in more unhealthy behaviours, one would expect a positive relationship between the two. We tested this hypothesis by examining associations between BIS and (a) total fat intake, (b) total sugar intake, (c) alcohol consumption, (d) likelihood of binge drinking, and (e) smoking frequency. However, as outlined above, it is possible that in some instances BIS may actually predict more *healthy* behaviours, because individuals with a more active BIS may experience more anxiety about health-related outcomes, which they may seek to reduce by engaging in more healthy behaviours. Such a relationship should only apply to variables that the individual is concerned about (e.g., that have been targeted in health promotion campaigns). Thus, an effect should be most apparent in relation to saturated fat and added sugar. Such an effect may also lead to a negative relationship between BIS and (c) alcohol consumption, (d) likelihood of binge drinking (e) likelihood of being a smoker, and (f) smoking frequency.

2. Method

2.1. Participants and procedure

Participants were 184 individuals (100 women; 92% White; M_{age} = 33 years, range 18–65) recruited in South Wales, UK via posters, flyers, press releases and online advertisements. 31% of the sample was educated to degree level or higher and mean BMI (based on self-report) was 25.19 (range = 14.10–42.60). Participants took part individually or in small groups. They completed measures of BIS/BAS, diet, BMI, alcohol use, smoking and demographics. Questionnaires relating to a separate study were interspersed between the measures. Participants were given £10 for participating.

2.2. Measures

2.2.1. BIS/BAS

Sensitivity to reward and punishment were assessed using the BIS/BAS scale, which has good psychometric properties (Carver & White, 1994). In the current study, Cronbach alphas were 0.80 (BIS), 0.79 (BAS), 0.80 (Reward Drive) and 0.71 (Fun Seeking).

2.2.2. Diet

Diet was assessed using a validated food frequency questionnaire (FFQ; Margetts et al., 1989) in which respondents record the frequency with which they consumed 63 food items over the previous month. The FFQ has good test–retest reliability (Armitage & Conner, 1999), good convergent validity with 10-day weighed records (Thompson & Margetts, 1993) and with 24-h dietary records (Margetts et al., 1989).

To compute daily intake of relevant macronutrients, we first calculated average levels of total fat, total sugar, saturated fat, and added sugar per gram of each of the 63 foods, based on data provided by the British Foods Standards Agency (2002, 2008). Each participant's daily intake of each food was then computed by multiplying frequency of consumption by average portion size. Average portion sizes were based on Bingham and Day (1987) and the British Foods Standards Agency (2008). Finally, for each food item, the amount of the relevant macronutrient per gram was multiplied by average daily portion size for each participant. These were then summed across the 63 foods to provide daily total intakes, in grams, of each of the four macronutrients, for each participant.

2.2.3. BMI

To compute BMI, participants reported their weight and height (at the end of the FFQ).

2.2.4. Alcohol use

Alcohol consumption was measured using a questionnaire developed by Cox (2003). It contains items asking about frequency