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Binge Eating and Impulsivity: The Use of a Delay Discounting Procedure to Elucidate the Relationship

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THESIS ABSTRACT

Lacey and Evans' (1986) Multi-Impulsivist Theory suggests that impulsivity is a key factor underlying the propensity to binge eat, and it may be equally or more closely associated with the core features of binge eating psychopathology such as negative affect and cognitive restraint. Theoretical perspectives are discussed and the literature review examines the relationship between binge eating and impulsivity by discussing the co-morbid symptomatologies that exist between binge eating and other impulse dysregulated disorders. A specific focus addresses the multi-dimensional nature of impulsivity and its inherent methodological and theoretical considerations. The literature review suggests that the use of a behavioural delay discounting procedure to measure impulsivity would elucidate the relationship between binge eating and impulsivity. The empirical study used a behavioural delay-discounting task to measure levels of impulsivity in a group of binge eaters and a group of controls. It also investigated the utility of using a delay discounting procedure to understand the 'loss of control' phenomenon in binge eating behaviour. In line with previous research, both self-report and delay-discounting measures evidenced significantly higher levels of impulsivity in binge-eaters, although a lack of correlations between behavioural and self-report measures were identified. The study provides preliminary evidence suggesting that the delay-discounting model may be a useful utility to predict the 'loss of control' phenomenon inherent in binge eaters, although future research is required to consolidate and support this utility. These findings have implications for clinical interventions, which may lead to the development of more effective treatments.

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Binge Eating Behaviour – The Role of Impulsivity: A Review

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Binge eating and impulsivity

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ABSTRACT

Binge eating is a significant public health problem characterised by persistent difficulties with emotional, medical, and social functioning. In trying to better understand and therefore improve the assessment, prevention and treatment of binge eating, researchers have considered the role of impulsivity. The precise nature of the relationship between impulsivity and binge eating remains unclear however, since various methodological problems within existing research have led to inconsistent results. The current paper will discuss evidence relating to the relationship between binge eating behaviours and impulsivity with a specific focus on the multi-dimensional nature of impulsivity and the inherent methodological and theoretical considerations that besiege current research. Future directions for research and clinical practice are considered.

Key words: binge-eating, bulimia, binge-eating disorder, bulimarexia, impulsivity, impulse dysregulation.

INTRODUCTION

Overeating has long been an accepted aspect of human behaviour dating back to the well-known Roman orgiastic binges, with today's holiday feasts likewise reflecting both the social norms of favouring heavy eating and the frequent personal enjoyment of hyper-satiety. The "battle of the bulge" now appears to be the culture war of the new century, and the World Health Organisation has declared obesity a global epidemic (WHO, 2003). Because overeating is such a frequent behaviour in overweight adults (Fairburn & Wilson, 1993; Gormally, Black, Daston, & Rardin, 1982; Grisset & Fitzgibbon, 1996), it is now becoming apparent that the scientific community will come under increasing pressure to answer the question of why so many people eat so much that they become obese or threaten their physical well-being.

Definition of Binge-eating

Various conceptualisations of pathological overeating have been described and discussed in the literature. Binge eating is defined by (a) the consumption of a large[1] amount of food, (b) where the episode occurs within a discrete period of time[2], and (c) with a perception of loss of control over eating during the episode (APA, 1994). Not all binge eaters reach full criteria for binge eating disorder (BED) for such reasons as insufficient frequency or size of episode, even though intense distress and impairment are experienced. BED is characterised by recurrent binge-eating episodes associated

[1] "large" is defined as "an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances"

[2] The research of Johnson, Boutelle, Torgrud, Davig and Turner (2000) supports the criterion that binges must occur within a discrete period of time, i.e. eating at a substantially faster rate than normal or eating more food than most people could consume in a short amount of time.

with marked distress, but without compensatory behaviours. Bulimia nervosa (BN) is another conceptualisation of overeating, characterised by frequent bouts of overeating but with the habitual use of vomiting or laxatives to compensate for the binges. Thus, one of the major qualitative distinctions between the diagnostic criteria of BED and BN is that purging, or other compensatory behaviours, are required for a diagnosis of BN, whilst these behaviours are exclusionary criteria for (and thus absent in) BED. Bulimarexia is another disordered eating pattern in which the person alternates between strong cravings for food and aversion to food; characterised by excessive eating followed by periods of fasting or self-induced vomiting. Table 1 summarises the key features of these disorders.

Table 1.

Underlying characteristics of eating disordered clients.

	Consumption of a 'large' amount of food	Consumption within a discrete period of time	Compensatory behaviours (i.e. fasting, laxative abuse, self-induced vomiting)	Associated distress	Sense of Loss of Control over eating
Binge Eating (BE)	√	√	X	X	√
Binge Eating Disorder (BED)	√	√	X	√	√
Bulimia Nervosa (BN)	√	√	√	X	√
Bulimarexia	√	√	√	√	√

For the purpose of this review, it is binge-eating, as a symptom of disordered eating pathologies (as opposed to the purging aspect, defined by associated compensatory behaviours) that will be discussed throughout this paper regardless of whether it is part of a broader pattern of bulimia, bulimarexia, or BED .

Prevalence

It is surprisingly difficult to estimate the prevalence of binge eating because different studies have used different definitions and different sampling methods. Reports of the prevalence of binge eating behaviours have ranged between 3% and 90% of the female population and from 1% to 64% of the male population (Connors & Johnson, 1987). Not all binge eaters are obese, but among obese adults seeking help for obesity, binge eating without purging appears to be a significant problem with an estimated prevalence rate of 20-50% (Decaluwe & Braet, 2003). Given that obesity affects 34 million American adults, the prevalence of the problem is substantial, particularly as the obesity problem is steadily rising every year in both children and adults (Anderson, Cohn & Holbrook, 2000; Fairburn & Bromwell, 2002; Ogden, 2003). The Dept of Health (DoH) reported in 2005 that the prevalence of obesity has now reached 24% in both males and females in England (see table 2).

Table 2.

Prevalence rates of obesity in England 2005 (ages 18-64).

Males		Females	
Overweight	45%	Overweight	33%
Obese	24%	Obese	24%
Normal Weight	27%	Normal Weight	38%

Methodological Considerations of Binge Eating Criteria

'Atypical' eating disorders, such as binge eating, where the frequency of binges is too low, or binge size is too small to be diagnostically categorised, are

classified as an example of an eating disorder not otherwise specified (EDNOS). Thus, those who fail to meet full criteria for BED would attract this label. Unfortunately, research often overlooks 'atypical' eating disorders and focuses on Bulimia Nervosa, Bulimarexia or BED. This has two consequences. First, research which fails to view eating disorders in their entirety, may miss potentially important theoretical commonalities. Second, by only providing treatment for those who have been clinically diagnosed with DSM-IV criteria for an eating disorder, this has left the needs of a large population of clients being ignored (Fairburn & Walsh, 2002), despite the fact that they too may experience high levels of distress and impairment.

The APA has strict criteria as to what constitutes an eating disorder but much research has questioned whether the criteria for binge eating disorder is valid (Latner & Clyne, 2008). Fairburn and Cooper (1993) re-conceptualised what constitutes binge eating using the Eating Disorder Examination (EDE) which classifies episodes of bingeing into two categories, (i) objective binge eating: loss of control and objectively large amount consumed; and (ii) subjective binge eating: loss of control and small amount consumed even though the individual views intake as excessive (Fairburn & Wilson, 1993, p.6).

In recent years, researchers have further questioned the requirement that a binge-eating episode consist of a large amount of food (Pryor, 1995; Wilson, 1992). Pratt, Niego and Agras (1998) conducted a study to examine whether objective and subjective binges differed significantly from each other in relation to measures of psychopathology in a sample of women who met DSM-IV diagnostic criteria for bulimia nervosa. Using baseline data from the Eating Disorder Examination (EDE), differences were analysed between objective and subjective binge episodes. Results identified a lack of significant findings, questioning the diagnostic validity of the

"large amount of food" criterion used to define binge eating in the DSM-IV. Furthermore, Rossiter and Agras (1990) found that nearly one-third of all binges in bulimics consisted of fewer than 500 kcal. Further research argues that *loss of control,* and not the *amount of food consumed,* is the crucial element in binge eating (Johnson, Carr-Nangle, Nangle, Antony & Zayfert, 1997; Pratt et al, 1998). Johnson, Robertson-Nay, Rohan and Torgrud (2003) conducted research that provided overall support for all three DSM-IV criteria for binge eating (food quantity, loss of control, duration of episode), but they evidenced especially strong support for the loss of control criterion. Similarly, 82% of women with BED used the criterion of loss of control to define their own binges (Telch & Agras, 1996). Furthermore, Latner, Hildebrandt, Rosewall, Chisholm and Hyashi (2007) conducted a study to examine the clinical significance of loss of control over eating as a key component of binge eating. They recruited a community sample of 81 women with a range of eating disorders and interviewed them using the EDE and completed measures of eating related and general psychopathology. They found that, regardless of level of intake (subjective or objective), loss of control over eating was clinically significant in itself. Overall, research on binge eating suggests the experience of a loss of control over eating may be a clinically significant and meaningful symptom and may require specific attention in treatment, with some researchers believing that a broadening of certain diagnostic criteria for binge eating episodes and BED might more accurately reflect the research literature and increase the number of individuals eligible for inclusion in treatment programmes.

Consequences of Binge Eating

Binge eating is a significant public health problem that persists despite substantial adverse consequences for individuals, families, and society at large. It has been suggested that binge eaters can experience such medical consequences as an increased risk of chronic disease, i.e. diabetes, cancer (Hu, 2003), high blood pressure, high cholesterol levels, heart disease; social consequences (prejudice, unemployment, bullying, discrimination, educational access, stereotyping) and emotional consequences (low self-esteem, depression, body dissatisfaction, guilt, and feelings of shame). Consequently, recurrent interpersonal difficulties ensue and sufferers may have difficulty coping with stressful situations due to a lack of assertive skills (Loro & Orleans, 1981; Wilson, 1976).

THEORETICAL CONSIDERATIONS OF BINGE EATING

Many psychological theories have been proposed to explain the eating behaviours of binge eaters. This paper will now discuss the history of the most prevalent of these theories, and will then elaborate on the more recent Multi-Impulsivist Theory.

Psychosomatic Theory

Psychosomatic theory (Bruch, 1961) originated from clinical observations in (mostly) psychiatric settings that the majority of obese individuals overeat when anxious, depressed, or lonely. A normal response to emotional arousal or stress is loss of appetite as emotional arousal inhibits gastric motility. However, for some individuals, emotional arousal and stress lead to an excessive intake of food. This so-designated emotional eating is, according to psychosomatic theory, found in individuals with a lack of interoceptive awareness. They are not very well able to

recognize whether they are hungry or satiated, or suffering from some other discomfort and thus may overeat in response to any arousal state. However, early tests of psychosomatic theory failed to give support for the model. Schachter, Goldman and Gordon (1968) conducted experiments identifying that obese participants did not label gastric contractions as hunger and, furthermore, in a high fear condition, the obese ate only trivially and non-significantly more than they did in low fear conditions. This study could therefore not support the physiological theory, or the arousal hypothesis, but concluded that overeating is triggered by external food-related stimuli. This finding led to a development known as Externality Theory (Schachter et al, 1968).

Externality Theory

In contrast to the emphasis placed on internal physiological, and emotional factors in psychosomatic theory, externality theory (Schachter et al, 1968) focuses on the external food environment as a determinant of eating behaviour. Overweight individuals are considered as being hyper-responsive to external food-related cues. Results from laboratory studies have shown differences in responsiveness to food between obese and normal weight adults but despite these initial successes, subsequent studies have failed to replicate the major findings (Rodin, 1981). Recently, Birbaum, Blackburn, Chandler, Corcoran, Hagan, Oswald, et al (2002) found that, in their binge eating group, seeing food, smelling food, seeing others overeat, or simply thinking about food was not related to binge eating behaviour. Thus, externality theory could not always be confirmed (Rodin, 1978; Rodin, 1981), and it was 'replaced' by restraint theory.

Restraint Theory

Restraint theory (Herman & Polivy, 1980), in contrast to both psychosomatic and externality theories, attributes overeating to dieting. This paradoxical notion is based on the contention that each individual has his or her own homeostatically regulated range of body weight. Attempts to lower body weight by conscious restriction of food intake initiates physiological defences, such as a lowering of the metabolic rate and arousal of persistent hunger. When self-control is undermined by disinhibitors, such as alcohol, anxiety, or depression, the cognitive resolve to diet may be easily abandoned. Counter-regulation may then occur, resulting in excessive food intake. In addition, continuous denial of hunger may result in a loss of contact with feelings of hunger and satiety. Thus, intense dieting may ultimately result in obese eating patterns (that is, emotional or external eating), since both arousal and external stimuli disrupt the cognitive restraint normally exercised by dieters faced with persistent hunger (Herman & Polivy, 1980).

The restraint theory posits that by decreasing attitudinal and behavioural restraints on eating behaviour, this will ultimately reduce the pressure to binge and a substantial number of controlled trials have shown that such interventions are effective (Fairburn, Jones, Peveler, Hope & O'Connor, 1993; Mitchell, Pyle, Pomeroy, Zollman, Crosby, Sein et al, 1993). However, more recent studies have consistently found that bulimic symptoms in highly impulsive bulimics can hardly be influenced by such treatment (Keel & Mitchell, 1997). Furthermore, violations of dietary restraint do not necessarily lead to binge eating in either normal-weight women (Charnok, 1989) or obese women (Ruderman & Wilson, 1979; Spencer & Fremoux, 1979).

Despite its simplicity, restraint theory has questionable applicability to overweight persons (Ruderman & Wilson, 1979), and it cannot explain the shift in set-point weights over the last decade given the recent increase in obesity prevalence. In addition, its validity for normal weight individuals can be questioned, as in some recent studies, tendency toward overeating was a better predictor for overeating than restraint (Ouwens, Van Strien & Van der Staak, 2003; Ruderman, 1986; Westenhoefer, Broeckman, Munch & Pudel, 1994). The individuals most at risk are not those who are restrained but do not overeat; it is those who show the combination of high restraint and a high tendency to overeat, therefore having susceptibility towards failure at restraint (Van Strien, Cleven & Schippers, 2000). These observations suggested that attempts to regulate food intake might be a cause of, and not simply a response to problems of eating control.

Escape Theory

The Escape Theory (Heatherton & Baumeister, 1991) proposes that binge eating is motivated by a desire to escape from self-awareness. Heatherton & Baumeister (1991) propose that binge eaters suffer from high standards and expectations, especially an acute sensitivity to the difficult (perceived) demands of others. When they fall short of these standards, they develop an aversive pattern of high self-awareness, characterised by unflattering views of self and concern over how they are perceived by others. These aversive self-perceptions are accompanied by emotional distress, which often includes anxiety and depression. To escape from this unpleasant state, binge eaters attempt the cognitive response of narrowing attention to the immediate stimulus environment and avoid broadly meaningful thought. This narrowing of attention disengages normal inhibitions against eating and fosters an

uncritical acceptance of irrational beliefs and thoughts. Following escapes from self-awareness, eating and a reduced affect co-occur. This theory characterises the individual's natural state as one of disinhibition and indulgence. The individual in this state has no self-control and does not respond to the inhibitions and constraints resulting from norms of acceptable behaviour. This theory of an escape from negative affect is proposed to be overly simplistic (Allison & Heshka, 1993) and emotions, particularly anxiety, are believed to interact with other factors to influence eating, such as the concept of self-control.

Multi-Impulsivist Theory

The Multi-Impulsivist theory (Lacey & Evans, 1986) posits that the high co-morbidity of disinhibited behaviours amongst binge eaters represents an underlying personality trait of multi-impulsivity, and presents them as a group suffering with 'multi-impulsive personality disorder'.

Lacey and Evans' (1986) theory is supported by a large body of evidence suggesting that multiple patterns of impulsivity are common and very strongly associated with the presence of binge eating. Indeed, Garfinkel, Moldofsky and Garner (1980) comment on the 'variety of impulsive behaviours' in the bulimic subgroup in their series, stating that they abused alcohol, used street drugs more often, had stolen, mutilated themselves and made other suicidal acts more frequently. Pyle, Mitchell and Eckert (1981) also report similar findings, such that a number of their 34 clients describe sensations, prior to bingeing, reminiscent of those in the DSM-III definition of impulse control disorders. Furthermore, the figures for 112 consecutive attendees at the eating disorders clinic in St George's Hospital in London also show a very high prevalence of impulsive behaviours in bulimics.

Evidently, a variety of theories have been posited to account for binge eating and, rather than rejecting these as flawed, it is suggested that these often contain useful insights that can be seen as consistent with various parts of impulsivity.

This paper will now continue by discussing the findings regarding the co-morbid patterns of impulsivity associated with binge eating and, in doing so, address the discussion that impulsivity is a primary component underlying binge eating behaviours (Johnson et al, 1997; Pratt et al, 1998).

BINGE EATING BEHAVIOUR AND CO-MORBIDITY

Binge eating and Substance Misuse

Consistently high rates of co-morbidity are observed for eating disordered clients and substance misuse (Holderness, Brooks-Gunn, & Warren, 1994; Lavik, Clausen & Pedersen, 1991; Strober, Freeman, Bower & Rigali, 1996; Wilson, 1992; Wolfe & Maisto, 2000). Various types of alcohol and drug use have been shown to frequently co-occur in eating disorder clients with particularly strong associations for substance abuse and binge eating behaviours. Substance abuse or dependence has been reported in up to 55% of clients who binge eat and alcohol and stimulants are reported as being the substances most commonly abused. By comparison, results from the epidemiological National Co-morbidity Survey (NCS) indicate that the lifetime prevalence of substance abuse in women ranges between 4% (drug abuse only) and 18% (abuse or dependence of drugs and alcohol; Kessler, McGonagle, Zhag, Nelson, Hughes, Eshleman, et al, 1994).

When looking at substance use disordered clients, studies have also identified that eating disorders tend to occur significantly more often than in the general population (Higuchi, Suzuki, Yamada, Parrish & Kono, 1993) or in psychiatric

control groups (Grillo, Becker, Levy, Walker, Edell & McGlashan, 1995). Indeed, a review of 21 studies found a median of 20% of drug abusers reported a lifetime history of bulimic behaviours (range 8% - 41%) (Holderness et al, 1994). This figure greatly exceeds the population base rates for bulimia nervosa of 1% of women (Hsu, 1996).

When studying the co-morbidity of eating disorders and alcohol specifically, many community-based investigations have reported higher rates of alcohol use and dependence among participants with BN compared to non-bulimic controls (Garfinkel, Lin, Goering, Spegg, Goldbloom, Kennedy, et al, 1995; Kendler, MacClean, Neale, Kessler, Heath & Eaves, 1991). Kaye (1994) cites a study of alcoholics who admitted that alcohol was used to numb hunger and craving for food and was the only thing that could make them sleep after binge-purge cycles. Furthermore, in a recent study at St George's bulimia clinic in London, one quarter of the clinic's clients reported consuming over 36 units of alcohol a week, and 8% drank more than 50 units. In 1984, Brisman and Segal also noted high prevalence figures for alcohol abuse in bulimic clients and comment that their own clinical experience has included examples of "dually directional symptom substitution". Depending on the study analysed, the rates of alcohol dependence among disinhibited (as opposed to restrictive) eaters ranges from 14-49% and from 8%-36% for other drug dependencies (Lilenfeld & Kaye, 1996) with up to 40% of alcohol misusing women reporting a current or past history of disordered eating (Holderness et al, 1994).

When looking at the association between binge eating and drugs other than tobacco and alcohol, the association between binge eating and cannabis use is particularly strong, such that the probability of binge eaters reporting some

problematic drug use (as indicated by a score of one or more on the four Drug Abuse Screening Test items) is twice that of non-bingers (Ross & Ivis, 1999).

While some studies maintain that eating disorders drive substance abuse, many researchers assert that personality characteristics or environmental and biological factors that make individuals more prone to eating disorders also make these persons more likely to use/abuse substances. Thus, an eating disorder and substance abuse may provide a similar appeal to individuals with specific characteristics. Experiments to determine the factors that make patients vulnerable to both eating disorders and substance abuse focus on such personality traits as impulsivity (Vandereycken, 1990).

Binge Eating and Personality Disorders

Borderline Personality Disorder (BPD) theoretically depicts a highly impulsive personality disturbance. It has been shown to be highly associated with binge eating (Braun, Sunday, & Halmi, 1994; McLelland, Mynors-Wallis, Fahy & Treasure, 1991; Wonderlich, Swift, Slomik & Goodman, 1990), to predict a negative eating disorder course and to interfere with traditional eating disorder treatments (Johnson, Tobin & Dennis, 1990; Rossiter, Agras, Telch & Schneider, 1993; Steiger & Stotland, 1996).

According to a meta-analysis examining the prevalence of personality disorders in bulimia nervosa, the personality disorders most commonly associated with Bulimia Nervosa were borderline (31%), dependent (31%), and avoidant (30%) (Bornstein, 2001). The prevalence rate of borderline personality disorder specifically, in samples of bulimic clients, varies broadly from 1.9% (Pope, Frankenburg, Hudson, Jonas, & Yurgelun-Todd, 1987) to 48% (Sunday, Levey, &

Halmi, 1993) with sufferers of Bulimia Nervosa and BPD sharing common features such as impulsive behaviours, self-destructive tendencies and difficulties in affect regulation (Johnson et al, 1990; Rossiter et al, 1993; Steiger & Stotland, 1996).

Differences in prevalence rates vary however, dependent on the sample selection and the diagnostic procedures used. For example, in a meta-analytic review, Rosenvinge, Martinussen and Ostensen (2000) found that 44% of the bulimics in their study had BPD and, in a comparatively large sample of 137 clients, Milos, Spindler and Buddeberg (2003) reported that 69% of the bulimic patients had a personality disorder. However, Zeeck, Birindelli, Sandholz, Joos, Herzog, and Hartmann (2007) found that only 14% of their 240 bulimic patients were diagnosed as having borderline personality disorder.

Recently, investigators have noted that binge eaters may represent the individuals most at risk for personality disorders characterised by self-regulation deficits (Telch & Agras, 1996). This suggestion is supported by Sansone, Wiederman and Sansone (2000) who posit that obese women seeking psychological help for binge eating disorder are at a greater risk and should be carefully screened for BPD.

The relationship between borderline personality disorder (BPD) and binge eating is a potentially important one and one that might explain meaningful clinical observations among some samples of obese individuals and shed light on the occurrence of multiple areas of impaired self-regulation.

Binge Eating and Promiscuous Sexual Behaviour

A large body of clinical and empirical literature generated over the last 30 years, has linked eating disorders and sexuality (Wiederman, Pryor & Morgan, 1996) wherein women who binge have been shown to engage in such disinhibited

behaviours as promiscuous sexuality (Kaltiala-Heino, Rissanen, Rimpelae & Rantanen, 2003).

When compared with controls, women who binge-eat have reported earlier onset of sexual experience (Hames & Katz, 1988), above-average libido, greater sexual activity, a greater number of sexual partners (Beaumont, George & Smart, 1981), to engage in more frequent sexual fantasy (Rothschild, Fagan, Woodall & Anderson, 1991), and to have had a greater number of sexual experiences (e.g. anal intercourse) (Abraham, Bendit, Mason, Mitchell, O'Connor, Ward et al, 1985).

Wiederman (1996) also identified that the personality of binge-eating clients predicted an under-controlled, emotionally dysregulated personality. Their study evaluated eating disordered women from an eating disorders clinic (aged 11-56) and their sexual experience. They found of 131 anorectics, only 53% indicated they had sexual intercourse, whereas, of 319 bulimics, 85% indicated they had had sexual intercourse, which identifies a significant difference even after controlling for relevant covariates.

In a study by Eddy, Novotny and Westen (2004), 234 clinicians were asked to describe one of their eating disordered clients (age 16-65). Bulimic clients were described as being flirtatious and promiscuous with an under-controlled, emotionally dysregulated personality predicting impulsive sexuality above and beyond BN diagnosis. They indicated that a cross–cutting set of personality variables related to eating disorders appear to account for more variance in sexual attitudes and behaviour than eating disorder diagnosis or symptoms – patients who were emotionally dysregulated and under-controlled (i.e. bingers) manifested an impulsive and self-destructive style.

As in their eating, bulimic women are reported to feel out of control with their sexual impulses. Consequently, Lacey (1982) wrote "so interrelated are bulimia and sexual activity ... that they (bulimic women) may use intercourse or masturbation as a means of thwarting a bulimic attack, or, alternatively, gorging to sedation may be used to lower heightened sexual drive" (p. 64).

Wiederman et al (1996) and Irving, McClusky-Fawcett and Thissen (1990) proposed that the relationship between sexual experience and eating disorders might be due to the personality trait of impulsivity. This hypothesis is supported by the fact that both increased sexual behaviours (Cooper, Wood, Orcutt & Albino, 2003; Hoyle, Fejfar & Miller, 2000) and bulimia show consistent and significant relationships with impulsivity and disinhibition (Kaltiala-Heino et al, 2003). Furthermore, Weston and Harnden-Fisher (2001) identified three personality style characteristics of patients with eating disorders that may be relevant to understanding sexuality in eating disorders – perfectionism, an over-controlling personality, but, most specifically for disinhibited eaters, is their trait of impulsivity.

It appears therefore that, for at least a subset of eating disordered clients, it is the broader patterns of impulse and affect regulation that express themselves in multiple realms of life, such as dysregulated eating behaviours and sexual attitudes.

Binge Eating and Tolerance of Deviance

A high tolerance of deviance (behaviour problems correlated with socially deviant and impulsive attitudes) is a dispositional characteristic that often separates women who binge eat from normal eaters (Bulik, Sullivan, Carter & Joyce, 1997; Grau & Ortet, 1999; Lilenfeld, Kaye & Greeno, 1997; Palme & Palme, 1999).

Benjamin and Wulfert (2005), conducted a study to examine the relationship between certain characteristic dispositional variables and binge eating. They used a 20-item scale adapted from the Health Behaviour Questionnaire (HBQ; Jessor, Donovan & Costa, 1992, cited in Benjamin & Wulfert, 2005) to assess socially deviant attitudes in 78 binge eating female undergraduates. Tolerance of deviance positively correlated with binge eating and a canonical analysis indicated that binge-eating college women held socially deviant attitudes. Furthermore, Palme and Palme (1999) conducted a study to investigate the personality characteristics of 134 females seeking treatment for obesity and bulimia. They used a subscale of the Karolinska Scale of Personality, labelled 'ego strength' to measure participants' abilities in suppressing and controlling impulses contrary to social norms. They identified that bulimic women were found to behave in more anti-social ways than controls and they evidenced significantly less social desirability. These results are consistent with Problem Behaviour Theory (Jessor, Graves, Hanson & Jessor, 1968; Jessor & Jessor, 1977), which posits that both impulsivity and a proneness to anti-social attitudes (tolerance of deviance) are important factors involved in such problem behaviours as binge eating.

In fact, lack of self-control, or, impulsivity, has been proposed as the fundamental factor contributing to criminal behaviour (Gottfredson & Hirschi, 1990). When Casper, Eckert, Halmi, Goldberg and Davis (1980) compared bulimic and abstaining subgroups of anorectics with regard to their developmental and psychosocial history, they found that kleptomania was almost exclusively present in the bulimics.

Binge Eating and Self-Injurious Behaviour

Patients with eating disorders have been suggested to be at high risk for self-injurious behaviour (Garfinkel & Garner, 1982) – a highly significant effect of response disinhibition. A few studies have investigated the occurrence of eating disorders in self-injuring patients, yielding eating disorder rates ranging from 61% in the largest study (Favazza, & Rosenthal, 1993) to 100% in others. Rates of suicide are also high among bulimics with estimates ranging from 9% - 20% - a much higher prevalence than the general population (Heatherton & Baumeister, 1991).

Yager, Landsverk, Edelstein and Jarvik (1988) found roughly one-third of their sample of bulimic subjects had some history of intentional self-injurious behaviour. More recently, Paul, Schroeter, Dahme, and Nutzinger (2002) assessed the lifetime occurrence and phenomenology of self-injurious behaviour in 376 patients with eating disorders. They identified a lifetime rate of self-injurious behaviour at 34.6%, with the highest rates found in subjects with eating disorder not otherwise specified (35.8%) and bulimia (34.3%). Interestingly, they also identified that the onset of self-injurious behaviour occurred after the onset of the eating disorder for 48.9% of the bulimics and 29.8% occurred before the onset of the eating disorder.

In assessing bulimic attitudes and behaviours amongst 53 non-clinical females, Penas-Liedo and Waller (1999) identified that bulimic attitudes and behaviours among this non-clinical group were associated with impulsive behaviours overall but the link was primarily with self-harming behaviours. This study identified that the bulimia-self-harming association holds in both clinical and non-clinical populations.

Apart from marked similarities in sex ratio and age at onset, common psychopathological features of eating disorders and self-injurious behaviours have been observed. One primary line of research focuses on impulsivity. Since Lacey and Evans (1986) proposed the construct of a multi-impulsive personality disorder, deficits in impulse control have been investigated in self-injuring patients with eating disorders.

Binge Eating and Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is a neurological disorder that impacts individuals in three main areas – hyperactivity, inattention, and impulsivity, evidencing itself in blurting out answers before questions have been finished, having trouble waiting one's turn, and interrupting and intruding on others. Preliminary evidence suggests a co-morbidity between attention-deficit/hyperactivity disorder (ADHD) and obesity. Obese children in treatment are found to have a much higher incidence of ADHD (58%) than in the general population (10%) (Agranat-Meged, Deitcher, Goldzweig, Leibson, Stein & Galili-Weisstub, 2005). Moreover, Holtkamp, Konrad, Muller, Heussen, Herpertz, Herpertz-Dahlman et al (2004) found that, contrary to their hypotheses, children with ADHD had higher BMIs compared to reference values, and their ADHD sample included twice as many participants with obesity as expected. Furthermore, Cortese, Isnard, Frelut, Michel, Quantin, Guedeney, et al (2007) conducted a study to identify the clinical characteristics of obese adolescents with a higher probability of ADHD in an attempt to understand the potential factors underlying the co-morbidity between obesity and ADHD. The study found that bulimic behaviours were significantly associated with ADHD symptoms after controlling for depressive and anxiety symptoms.

Binge Eating and Negative Affect

Alongside many co-morbid impulse-dysregulation problems, binge eaters have also been identified as having elevated indices of depression (Marcus, Wing & Hopkins, 1988) and show greater concurrent mood disturbance than controls (Ruderman & Besbeas, 1992). Many theories (as discussed) and studies support a major role of negative affect in the psychopathology of binge eating behaviours (Grilo & Masheb, 2001; Stice, Agras, Telch, Halmi, Mitchell, & Wilson, 2001; Stickney, Miltenberger & Wolff, 1999). Indeed, the escape theory of binge eating suggests that binge eating occurs because it provides momentary relief from negative affect and as such, negative affect is the strongest predictor of chaotic eating behaviour amongst binge eaters. Such indices of negative affect may include feelings of anger, loneliness, sadness, stress or boredom.

The viewpoint that negative affect precedes bingeing behaviour does not at all exclude the possibility that it might also follow binge eating. Many authors agree that there is a vicious circle between negative affect and bulimic behaviours (Elmore & DeCastro, 1990; Johnson & Larson, 1982; Stice, 1998) in which negative affect can also be a consequence of bulimic behaviours. Frustration about persisting (Johnson-Sabine, Wood & Wakeling, 1984) and/or recurrent eating disturbances (Bekker, Croon & Bertrand, 2004) might play a role as well as depression evoked and/or maintained by restricted caloric intake. Birbaum et al (2002) identified that the marked distress associated with the consequences of binge eating can include such negative states as failure, defeat, shame, depression, guilt, decreased self-esteem and self-hatred.

The effect to which impulsive behaviour, such as binge eating, triggers negative affect (i.e. negative affect induced by an individuals despair at the difficulty they experience in controlling or coping with their impulsive behaviours), and the extent to which negative affect triggers binge eating, is an area for further investigation.

Transient mood swings may therefore be intricately woven into an individual's perception of their impulsive behaviours and it is believed that fundamental deficits in impulse control are closely related to an individual's difficulty in coping with depressive emotions and anxiety.

To summarise, all co-morbid behaviours associated with binge eating, show consistent and significant relationships with impulsivity, indeed, higher levels of co-morbid symptomatologies are indicative of higher levels of impulsivity (Bulik, Sullivan, Weltzin & Kay, 1995; Kane, Loxton, Staiger & Dawe, 2004). These specific problem behaviours tend to cluster together, such that individuals who exhibit one type of problem behaviour tend to exhibit a behavioural repertoire of engaging in several types of myopic or short-sighted behaviour.

This clustering of co-morbid tendencies appear to have common characteristics – each involves a loss of control, cravings, negative physical, social and occupational consequences and immediate gratification followed by long-term harm (Das, 1990). Various explanations for the correlations have been argued - (i) the different disorders have different causes, but the presence of one disorder may increase the person's chances of developing the others; (ii) an independent disorder causes the resultant co-morbid tendencies; (iii) the co-morbidities have some risk factors in common; (iv) the co-morbid disorders share manifestations of a shared underlying aetiology such that the similarities between binge-eating and its co-morbid

pathologies, are the result of a common underlying personality factor that drives these behaviours (Irving et al, 1990; Lacey & Evans, 1986; Wiederman et al, 1996). One such personality factor is that of impulsivity and this is the hypothesis that has attracted the most extensive attention recently as each of the behaviour problems that are prevalent among women who binge eat, show a predisposition to impulsive behaviour (i.e. substance misuse, cluster B personality disorders; sexual promiscuity; high tolerance of deviance; self-injurious behaviour, and/or ADHD).

In the previous sections, this paper has outlined the independent relationships of several dimensions of impulsive behaviour with binge eating. So far, it has been argued that a diverse set of risky or problem behaviours are related and this paper has discussed how these patterns of co-variation in binge eaters can be usefully modelled by a single higher-order factor – impulsivity, illustrated in Figure 1.

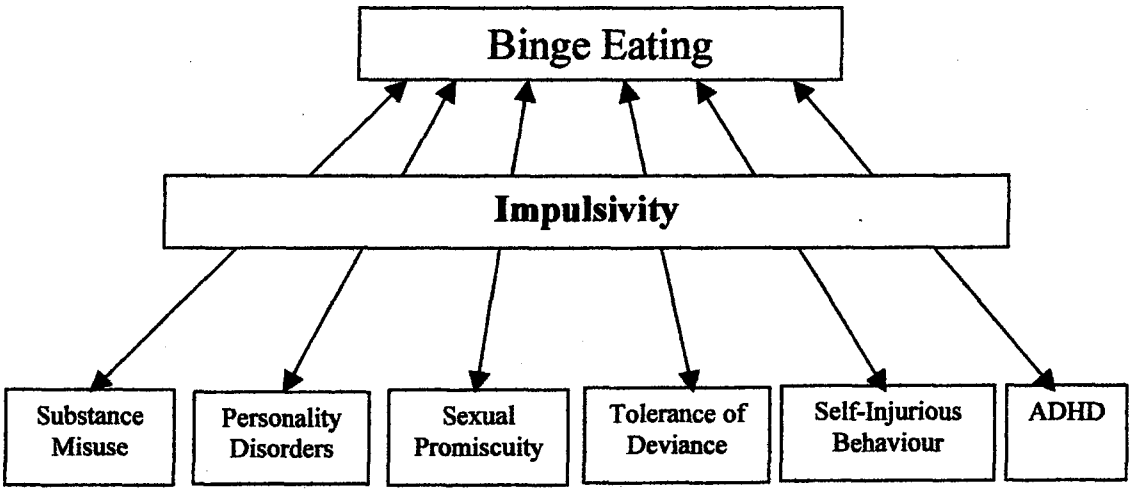

Figure 1. The third variable (moderator) model of impulsivity.

Consideration of important common attributes shared by diverse risk behaviours provides a useful starting point for identifying aspects of personality that might underlie binge eating and the generalised propensity to engage in such problematic behaviours. This paper will now consider the role of impulsivity in more detail.

CURRENT UNDERSTANDING OF IMPULSIVITY

Definition of Impulsivity

Impulsivity is a stable and enduring personality trait – a distinctive pattern of behaviours, thoughts, motives and emotions exhibited across situations that characterise an individual throughout life (Wade & Tavris, 2000). Not all impulsive behaviour is disadvantageous. It can play an important role in normal behaviour by adding important colour to everyday life and most of us succumb to impulsivity on a regular basis. However, there are differences between socially acceptable impulsive behaviours ("just one more drink") and socially unacceptable impulsive behaviours (sharing a hypodermic needle for drug use).

Personality traits, such as impulsivity, are longstanding, possibly originating in childhood or even having genetic origins and are believed to be antecedents of an inability at restraint, not a consequence. For example, Vitaro, Arseneault and Tremblay (1999) conducted a predictive study that found impulsivity in 12-14 year-olds predicted problem gambling at age 17 after controlling for early gambling behaviour and other relevant variables. Furthermore, Nagata, Kawarada, Kiriike and Iketani (2000) found that the majority (80%) of 'multi-impulsive' women in their sample of women with bulimia, had a history of impulsive behaviour *prior* to the onset of bulimia. The authors suggest that this temporal ordering indicates

impulsiveness as a general predisposition rather than a consequence of disordered eating. Such findings support the notion that impulsivity contributes to increased rates of co-occurring 'impulsive' behaviours in bulimic women.

Current literature defines impulsivity as (1) the inclination to choose small, immediately available rewards over larger, delayed rewards, and/or (2) the inclination to respond rapidly without forethought and/or attention to consequences. It has been described as "an action that is poorly conceived, prematurely expressed, unduly risky, or inappropriate to the situation and often results in undesirable outcomes" (Evenden, 1999).

As such, we are often confronted with choices between two rewards, a greater one that can be received only after some period of time, or a smaller one that can be received sooner, e.g. we might have to choose between enjoying better health in the future or engage in overeating now. Sometimes, we give in to the more immediate temptation, at other times, we forego immediate gratification and opt for the more delayed, but greater reward. Giving in to a more immediate temptation, as opposed to delaying immediate gratification for a greater reward, is representative of an impulsive personality trait.

There has been little attempt to conceptualise impulsivity within a theoretical model of human behaviour in the eating disorders field but this paper will now continue by discussing Gray's (1970) Reinforcement Sensitivity Theory.

The Reinforcement Sensitivity Theory of Impulsivity and Anxiety

Gray's (1970) theory of personality proposes two independent biologically based dimensions of motivation and personality - impulsivity and anxiety, both of which are significantly associated with disordered eating. According to Gray (1970),

impulsivity is the behavioural expression of individual differences in sensitivity to reward and to learned signals of rewarding stimuli in the environment (reward reactivity). Conversely, anxiety is the expression of individual differences in sensitivity to learned signals of punishment, novel stimuli and frustrative non-reward. These dimensions are mediated by two interacting brain systems that form the Behavioural Approach System (BAS), which regulates response to rewarding cues, and the Behavioural Inhibition System (BIS), which regulates an inhibited response to conditioned cues of punishment. Individuals with high BAS sensitivity are thought to be more prone to engage in approach behaviour and to experience positive affect in situations cued with reward. Such behavioural expressions of BAS reactivity appear to parallel the approach behaviour characteristics of binge eating. BIS, on the other hand, underlies the inhibition of behaviour, by increasing arousal and attention in response to conditioned cues of punishment and is thus implicated in the expression of negative affective states, also evident in binge eaters. Moreover, bulimic women with very high BAS sensitivity may be more likely to engage in numerous impulsive activities, including drug and alcohol abuse. Figure 2 identifies how an increased BAS and an increased BIS interact to produce the co-morbid pathologies often evidenced in binge eaters – impulsivity and negative affect.

Gray (1970) based his theory of impulsivity and anxiety on individual differences in susceptibility to rewards and punishers. If an immediate reward produces a stronger incentive in high-impulsive individuals than it does for low impulsive individuals, then they would be expected to be more likely to choose a smaller but more immediate reward rather than wait for a larger, delayed reward relative to low-impulsive clients.

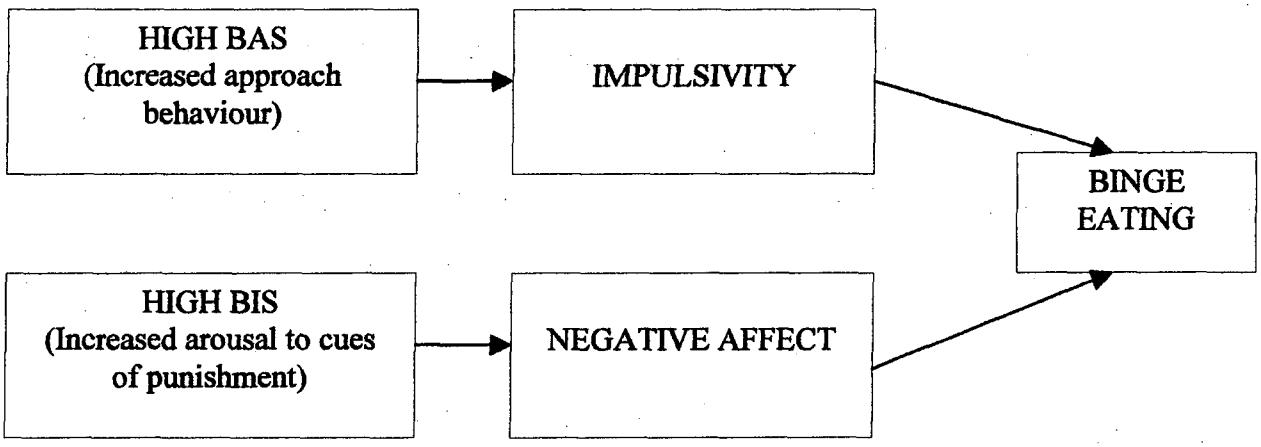

Figure 2. Link between negative affect and high levels of impulsivity evidenced in binge eaters.

Impulsivity as a multi-dimensional construct

Uncertainty about the best approach for conceptualising and measuring impulsivity has plagued eating disorder research. Given the importance of impulsivity in psychology, it is somewhat surprising to note the variety of current conceptualisations of impulsivity and the inconsistencies among them (Whiteside & Lynam, 2001). This is evidenced by Depue and Collins (1999) who note that impulsivity comprises a heterogeneous cluster of lower-order traits that includes terms such as "impulsivity, sensation-seeking, risk-taking, novelty-seeking, urgency, lack of pre-meditation, lack of perseverance, boldness, adventuresomeness, boredom susceptibility, unreliability, and unorderliness" (p. 495). Unfortunately, the measurement of impulsivity suffers from two fallacies. The first fallacy refers to situations in which two constructs with similar labels are in reality quite different; for example, measures labelled impulsivity may reflect constructs as diverse as a short attention span and a tendency to participate in risky behaviour. The second fallacy

refers to situations in which two constructs with different labels are actually labelled the same; for example, Tellegen's Control (Tellegen, 1982) and Zuckerman's Disinhibition (Zuckerman, 1994) scales seem to measure similar constructs despite bearing different labels. Clearly, these fallacies are more likely to inhibit than to advance the understanding of impulsivity and prevent the correspondences that could help build cumulative knowledge.

Evidently, impulsivity is a multi-dimensional construct yet there is still a lack of a coherent framework from which to conceptualise impulsivity due to the diverse domain of impulsivity measures that exist and these will now be discussed.

Measurement of Impulsivity

The variety of definitions that exist for impulsivity is matched by a range of measures used to quantify its construct. Measurement of impulsivity may be divided into experimental and psychometric approaches. A primary distinction between these approaches is the measurement of ongoing behaviour under experimentally controlled conditions versus the identification of personality traits from factor-analysed questionnaire items. Most psychometric instruments consist of multiple subscales, as well as a total score, and the nature of the questions comprising the tests cover a broad range of dimensions. Some instruments are specifically focussed on the impulsivity construct; others are part of a more global personality assessment that includes subscales that may correspond to impulsive personality traits. The surprising variety of disparate measures that span the self-report and behavioural domains of impulsivity, show either modest inter-correlations or no correlations between measures (Mitchell, 1999), suggesting different underlying conceptions of the construct (Monterrosso & Ainslee, 1999) and making convergent and divergent

evidence for the nature of the relationship between impulsivity and eating disorders extremely difficult.

Trait-based & Self-Report Measures

Trait-based, self-report measures, as a source of information regarding cognitive processes in disordered eaters, are notoriously unreliable (Faunce, 2002) and are unlikely to illuminate more fundamental behavioural processes that may be entailed in impulsiveness. However, trait-based self-report measures are the most widely used assessments of impulsivity and such measures include the BIS/BAS scales (Carver & White, 1994), based on Gray's (1970) Reinforcement Sensitivity Theory; the Temperament & Character Inventory (TCI; Cloninger, Svarik & Przybeck, 1993); the Barrett Impulsivity Scale (BIS-II; Patton, Stanford & Barrett, 1995); the Eysenck Impulsiveness Scale (I7; Eysenck & Eysenck, 1977); and the Sensation Seeking Scale (SSS; Zuckerman, 1979), to name but a few. Although somewhat overlapping, the precise aspects of impulsivity differ somewhat across these measures. Specifically, the BIS/BAS scales reflect the general conceptualisation of BIS and BAS, focussing on items that tap emotional responses to appetitive and aversive stimuli. It provides a single score for BIS and three subscale scores for BAS – drive, fun-seeking, and reward responsiveness. The TCI is designed to measure biologically influenced temperament traits such as novelty-seeking, harm avoidance, reward dependence and persistence as well as more complex and broad character dimensions including self-directedness, co-operativeness and self-transcendence. The BIS-II is designed to measure three distinct areas in which individuals demonstrate impulsivity – motoric impulsivity (or proneness to reckless actions); cognitive/attentional impulsivity (or inability to maintain focussed attention);

and non-planning impulsivity (or lack of concern for the future). The I7 provides a single impulsivity factor score but is considered to be composed of non-planning, risk-taking and liveliness subscales of impulsivity. The Sensation-Seeking Scale (Zuckerman, 1979) measures four components – thrill and adventure-seeking, disinhibition, experience-seeking, and boredom susceptibility.

Each impulsivity measure has a widely differing number of subscales – with some measures providing a single impulsivity score and others positing multi-dimensional components. It is possible that each measure may assess impulsivity, but it is not possible that all assess the entire construct in its completeness and complexity without the inclusion of other related constructs.

Whilst the measures described above have a generic approach to measuring impulsivity, at a conceptual level they are quite different and thus we find that self-report measures of impulsivity, although often correlated (Helmers, Young & Pihl, 1995) do not provide uniformly consistent results. Unlike measures of anxiety and behavioural inhibition, which appear to tap a single construct, measures of impulsivity assess a number of related domains. Self-report measures are primarily descriptive of behavioural tendencies in complex social situations and, as such, are unlikely to illuminate more fundamental behavioural processes that may be entailed in impulsiveness. Self-report assessments typically present hypothetical situations and ask the participant to report how he/she would behave in a given situation. This type of questioning assesses one's subjective sense of a tendency and/or subjective comparison of self, relative to perceived behaviours of others, rather than actual behaviours.

Another difficulty among existing self-report assessments of impulsivity is that non-impulsive individuals may endorse items regardless of their actual

behaviours. For example, on such items as "Do you feel at your best after taking a couple of drinks?" (I-7; Eysenck & Eysenck, 1977), a participant might endorse this item if they are socially insecure and timid and, with intent and forethought, drink to feel a bit more relaxed. In this case, the shy individual might endorse the item in a belief that drinking might make him/her less inhibited and not because he/she is impulsive.

Self-report measures of impulsivity evidently have shortcomings, not least the question of the ability of clients with impulsivity problems to assess their own cognitive functions and the fact that self-report methods may be affected by automatic (e.g. failure to remember) and/or strategic (e.g. lying) distortions in responding.

Trait orientated measures of impulsivity are a less sensitive measure of impulsivity than behavioural measures (Wonderlich, Connelly & Stice, 2004). Indeed, Wonderlich et al (2004) found that trait impulsivity, measured with traditional personality scales such as the 16PF Impulsivity Scale (Cattell, Eber & Tatsuoka, 1970), failed to predict the onset of eating disorder behaviour in all of their three studies. However, when behavioural constructs associated with impulsivity, such as delinquency or substance abuse, were examined, they significantly predicted the onset of eating disorder behaviour in most of the analyses conducted.

Furthermore, in a recent study with adults, Wonderlich, Crosby, Smyth, Miltenberger, and Mitchell (2003) found that eating disordered women with rigorously diagnosed BPD (i.e. behaviourally impulsive) did not differ from other bulimic women on a personality trait measure of impulsivity. It may be that generic measures of trait impulsivity assess a broad construct that is not specific to eating disorder behaviour.

Nonetheless, research using self-report methodology, has begun to demonstrate a link between overeating and impulsivity. Nasser, Gluck, and Geliebter (2004) have shown that binge eating disorder (BED) clients score significantly higher on the Barrett Impulsivity Scale compared to controls. They also found positive significant correlations between clients' impulsivity score and the BED criteria "loss of control during a binge". Recently, it has been shown that even in healthy, lean participants, impulsivity is of importance when it comes to food. Healthy individuals who are more sensitive to reward according to a self-report questionnaire turned out to have more pronounced neural responses to images of appetising food (Beaver, Lawrence, Van Ditzhuijzen, Davis, Woods & Calder, 2006). This could indicate that for high-impulsive people, it is harder to resist food than for low-impulsive people. Indeed, Guerrieri, Nederkoorn, Stankiewicz, Alberts, Geschwind, Martin et al (2007) found that high impulsive women ate more during a bogus taste test than their low-impulsive peers when impulsivity was measured by self-report.

Behavioural Measurement of Impulsivity

Given that both self-report and trait-based measurements of impulsivity are somewhat limited, recent research has concentrated on assessing impulsivity using behavioural tasks. Many behavioural measurements exist and include such measures as the Matching Familiar Figures Test (MMFT; Kagan 1966); the Simple Reaction Time Task (SRTT; Barratt & Patton, 1983); the Card Arranging Reward Responsiveness Objective Test (CARROT; Powell, Al-Adawi, Morgan & Greenwood, 1996); and the GO/NO GO task (e.g. Newman, Patterson, Howland & Nichols, 1990).

The GO/NO GO is a computerised measure of impulsivity where participants must attempt to execute or inhibit their responses depending on whether a 'GO' or 'NO GO' stimulus appears on the screen (eg. Rubia, Oosterlaan & Sergeant, 1998). Participants must learn to press or not to press a button as a consequence of positive or negative feedback received during a trial and error learning task. Correct presses are rewarded with positive feedback (and often, a small monetary gain) and incorrect presses are punished with negative feedback (and a small monetary loss). A small, yet emerging body of literature indicates that individuals with impulse control problems demonstrate a significant reduction in reflection on the negative feedback and a significant increase in the number of passive-avoidance errors committed on the task, implying an inability to take sufficient time to pause and reflect on one's errors (eg. Newman, Patterson & Kosson, 1987; Newman et al, 1990). This reduced reflection on negative feedback then decreases the opportunity to evaluate and correct one's responses, in turn, increasing the likelihood of future maladaptive behaviour. For example, Bruce, Koerner, Steiger and Young (2003) used the GO/NO GO to investigate the extent to which laxative misuse in bulimic clients, corresponds to impulse control problems. They identified that bulimics who misused laxatives made more errors on the GO/NO GO under cues for punishment indicating that they were more disinhibited when faced with negative outcomes.

The Card Arranging Reward Responsiveness Objective Test (CARROT, Powell et al, 1996) measures the increase in speed on a simple card-sorting task in response to a small financial reward. It is a behavioural measure that involves a reaction time component and thus may bias the responses of anxiety sufferers – a relatively apparent co-morbid symptom of binge eating. Using the CARROT, Dawe

and Loxton (2004) found women with a bulimia diagnosis to sort cards significantly faster during a financially rewarded condition than non-bulimic women.

The Matching Familiar Figures Test (Kagan, 1966) consists of a standard figure that is presented with eight additional similar figures, one of which is an exact duplicate of the standard figure. The participant's task is to select the standard's exact duplicate from the alternatives. Dependent measures are elapsed time to the participant's initial response (latency score) and number of errors made before arriving at a correct response (error score).

The Simple Reaction time task (Barrett & Patten, 1983) incorporates the idea that impulsive individuals will, due to their increased cognitive tempo, respond more quickly than non-impulsive individuals. The participant's task is to respond as quickly as possible to a cue stimulus by performing a task, i.e. covering a photoreceptor cell with his/her finger, thereby shutting off the tone.

Each of the above behavioural measures incorporates either/or a reaction time component, or an error rate component – such trials are highly anxiety provoking and their validity is questionable (Block, Block & Harrington, 1974).

Although such performance tests may provide a relatively sensitive assessment of impulsive behaviour and they are free from the limitations of subjects' recall, lack of honesty, limited insight and concerns over social desirability, these tasks do not incorporate the social aspects of impulsivity, making them ecologically invalid, and they do not take into account impulsiveness resulting in beneficial outcomes for the individual. Performance on any one test might only assess a single component of impulsiveness, rather than a general trait.

The relationship between increased impulsivity and the problem of overeating is quite robust since it generally persists even when impulsivity is measured in

different ways (self-report versus behavioural tasks; response inhibition versus sensitivity to reward) however, stronger research designs involving behavioural measurements of impulsivity would help validate the self-report methodology. Indeed, other researchers have found that specific dimensions of impulsivity relate differentially to self-report versus behavioural indicators of the construct (Butler & Montgomery, 2004), and the correlations between these different methods of measurement are often low (Gerbing, Ahadi & Patton, 1987; Lane, Cherek, Rhodes, Pietras & Tcheremissine, 2003; Morgan, 1998).

The Delay Discounting Measure of Impulsivity

It is suggested that a particularly objective behavioural approach to understanding impulsive choice in binge eating individuals is the analysis of delay discounting (Green, Fristoe & Myerson, 1994) which measures how people make trade-offs between larger, delayed rewards, and more immediate, smaller rewards, such that impulsive individuals prefer smaller immediate rewards over larger delayed rewards (Ainslie, 1975; Kirby, Petry & Bickel, 1999; Mischel, 1984; Rodriguez, Mischel & Shoda, 1989). The delay discounting procedure appears to intuitively correspond with Gray's (1970) theory of impulsivity, discussed earlier, which is also based on individual differences in susceptibility to reward. Impulsive individuals will also often place themselves in a position to defer excessive long-term costs in exchange for modest short-term gains (e.g. Baumeister & Scher, 1988; Cooper et al, 2003; Kirby et al, 1999). Similar to delay discounting at a conceptual level, delay of gratification differs somewhat on a measurement level. Specifically, unlike delay discounting where one makes a permanent choice between an immediate smaller reward and a delayed larger reward, the primary interest in the delay of gratification

procedure is the ability to sustain the choice of the delayed reinforcer while the smaller, immediate reinforcer is continually available.

A commonly used discounting procedure was developed by Rachlin, Raineri and Cross (1991) who asked participants to choose between monetary rewards (ranging from $1 to $1000) obtained either immediately or following a series of delays (ranging from 1 month to 50 years). For each delay, a computer programme adjusts the amount of the immediate reward until the immediate and delayed rewards are of equivalent subjective value. The reduction in the amount of the immediate reward at the indifference point compared to its original amount provides a measure of the present subjective value of the delayed reward and is thus indicative of an individual's impulsivity level.

This task does not involve error rates or reaction times; it measures impulsiveness as a result of a beneficial outcome for participants and asks participants to make choices relative to normal life situations. This approach has been successfully utilised as a measure of impulsivity in clients suffering from substance dependence (Baker, Johnson & Bickel, 2003; Kollins, 2003; Monterosso, Ehrman, Napier, O'Brien & Childress, 2001; Petry, 2001), gambling (Petry & Casarella, 1999), alcohol (Petry, 2002); and smoking (Bickel, Odum & Madden, 1999) but as yet, has not been applied to the eating disordered population. The concepts of delay discounting and delay of gratification represent an objective behavioural approach that could be used to further understand the crucial relationship between binge eating and impulsivity and could lead to a more comprehensive framework with which to consider this complex role.

CLINICAL IMPLICATIONS FOR FUTURE RESEARCH AND TREATMENT

Thus far, this paper has considered the substantial adverse consequences, both to the individual and society itself, of binge eating. It has discussed the methodological and theoretical considerations of binge eating research and discussed in length the concept of Lacey & Evans' (1986) multi-impulsive personality theory as being an important underlying factor in the propensity to binge eat.

In order to clarify the role of impulsivity in binge eating, this paper has suggested that, due to the multi-dimensional construct of impulsivity and the difficulties this causes in measuring the construct, that a stronger research design is required using clinical samples and ecologically valid paradigms. Many studies use tasks that can be anxiety provoking or are susceptible to the pitfalls of latency scores, or error rates and thus, there is a need for an objective behavioural measurement of impulsivity that is ecologically valid and unresponsive to social desirability. As such, it is suggested that the application of a delay-discounting task to the study of binge eating would enhance existing knowledge and help validate existing research.

The multiple impulsivity of many clients attending specialist-eating clinics is already a problem of such significance as to justify consideration of a general model of impulsivity. This would facilitate development of treatment methods giving more importance to the management of delayed gratification and control of impulsivity. In particular, it would allow the development of treatments to deal with the interchangeable nature of impulsive symptoms. Thus for example, if binge eating is addressed in the Eating Disorders Clinic, the client may stop bingeing but move to alcohol or cutting. These impulsive symptoms tend to be transposable making these clients unpopular so that they drift from clinic to clinic. Only by concentrating on the underlying psychopathology can all the symptoms be tackled. In particular,

awareness of the many secretive forms of impulsivity that are associated with binge eating, (such as substance abuse, tolerance of deviance, personality disorder, self-injurious behaviour and promiscuity), could alert the clinicians to symptom substitutions which tend to thwart focused eating disorder therapies.

Consideration of impulsivity within binge eating would encourage interventions aimed at improving self-control, i.e. exposure and response prevention, impulse control skills (like those suggested by Linehan (1993) for the treatment of BPD), and temptation with exposure prevention (TERP). Existing interventions aimed at addressing dietary restraint consider a dimension that is only peripheral to the maintenance of an individual's binge eating behaviour and may explain the poor prognosis associated with existing obesity treatments.

If discounting measures can be shown to be correlated with binge eating behaviours, then such measures could be used to better allocate prevention and treatment resources (Bickel & Marsch, 2001) and perhaps even match individuals with prevention or treatment approaches that would be most effective for them.

At present there is a large body of literature that suggests that impulsivity plays a key role in the maintenance of binge eating. However, our knowledge and understanding about the detailed nature of impulsivity is limited. Nevertheless there is much interest in this area of research and the knowledge base continues to develop, which should build our understanding of the role of impulsivity in binge eating and consequently lead to the development of more effective treatments. In particular, we need to continue to examine Lacey & Evan's (1986) conceptualisation of impulsivity in relation to binge eating and broaden the scope of research to consider possible adaptive functions of the role of impulsivity in binge eating.

REFERENCES

Abraham, S. F., Bendit, N., Mason, C., Mitchell, H., O'Connor, N., Ward, J., et al. (1985). The psychosexual histories of young women with bulimia. *Australian and New Zealand Journal of Psychiatry, 19,* 72-76).

Agranat-Meged, A. N., Deitcher, C., Goldzweig, G., Leibson, L., Stein, M., & Galili-Weisstub, E. (2005). Childhood obesity and attention deficit/hyperactivity disorder: A newly described co-morbidity in obese hospitalised children. *International Journal of Eating Disorders, 37,* 357-359.

Ainslie, G. (1975). Specious reward: A behavioural theory of impulsiveness and impulse control. *Psychological Bulletin, 82,* 463-496.

Allison, D. B., & Heshka, S. (1993). Emotion and eating in obesity? A critical analysis. International Journal of Eating Disorders, 13, 289-295.

American Psychiatric Association. (1994). Diagnostic and statistical manual of ental disorders (4th ed.), Author, Washington DC.

Andersen, A., Cohn, L. and Holbrook, T. (2000) Making weight – Men's conflicts with food, weight, shape and appearance. USA:Gurze books.

Baker, F., Johnson, M. W., & Bickel, W. K. (2003). Delay discounting in current and never-before smokers: Similarities and differences across commodity, sign and magnitude. *Journal of Abnormal Psychology, 112,* 382-392.

Barratt, E. S., & Patton, J. H. (1983). Impulsivity: Cognitive, behavioural and psychophysiological correlates. In M. Zuckerman (Ed). *Biological Bases of Sensation Seeking, Impulsivity and Anxiety.* Hillsdale, NJ: Erlbaum.

Baumeister, R. F. & Scher, S. J. (1988). Self-defeating behaviour patterns among normal individuals: Review and analysis of common self-destructive tendencies. *Psychological Bulletin, 104*, 3-22.

Beaumont, P. J. V., George, G. C. W., & Smart, D. E. (1981). The psychosexual histories of adolescent girls and young women with anorexia nervosa. *Psychological Medicine, 6,* 617-622.

Beaver, J. D., Lawrence, A. D., Van Ditzhuijzen, J., Davis, M. H., Woods, A., & Calder, A. J. (2006). Individual differences in reward drive predict neural responses to images of food. *The Journal of Neuroscience, 26(19),* 5160-5166.

Bekker, M. H. J., Croon, M. A., & Bertrand, I. J. (2004). The relationship between parental attachment experiences, autonomy and eating disorders. *Manuscript submitted for publication.*

Benjamin, L., & Wulfert, E. (2005). Dispositional correlates of addictive behaviours in college women. Binge eating and heavy drinking. *Eating Behaviours, 6,* 197-209.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioural economic understanding of drug dependence: delay discounting processes. *Addiction, 96,* 73-86.

Bickel, W. K., Odum, A. L., & Madden, G. J. (1999). Impulsivity and cigarette smoking: delay discounting in current, never, and ex-smokers. *Psychopharmacology, 146*, 447-454.

Birbaum, M. C., Blackburn, K., Chandler, P. D., Corcoran, K. J., Hagan, M. M., Oswald, K. D., et al. (2002). Incidence of chaotic eating behaviours in binge eating disorder: contributing factors. *Behavioural Medicine, 28,* 99-105.

Block, J., Block, J. H., & Harrington, D. M. (1974). Some misgivings about the matching familiar figures test as a measure of reflection-impulsivity. *Developmental Psychology, 10,* 611-632.

Bornstein, R. F. (2001). A meta-analysis of the dependency-eating-disorders relationship: Strength, specificity and temporal stability. *Journal of Psychopathology and Behavioural Assessment, 23,* 151-162.

Braun, D. L., Sunday, S. R., & Halmi, K. A. (1994). Psychiatric co-morbidity in patients with eating disorders. Psychological Medicine, 24, 859-867).

Brisman, J., & Segal, H. (1984). Bulimia and alcoholism: Two sides of the same coin? *Journal of Substance Abuse Treatment, 1,* 113-118.

Bruce, K. R., Koerner, N. M., Steiger, H., & Young, S. N. (2003). Laxative misuse and behavioural disinhibition in bulimia nervosa. *International Journal of Eating Disorders, 33,* 92-97.

Bruch, H. (1961). Transformation of oral impulses in eating disorders: a conceptual approach. *Psychiatric Quarterly, 35,* 458-481.

Bulik, C. M., Sullivan, P. F. , Weltzin, T. E., & Kay, W. H. (1995). Temperament in eating disorders. *International Journal of Eating Disorders, 17,* 251-261.

Bulik, C. M., Sullivan, P. F., Carter, F. A., & Joyce, P. R. (1997). Lifetime co-morbidity of alcohol dependence in women with bulimia nervosa. *Addictive Behaviours, 22,* 437-446.

Butler, P., & Montgomery, A. M. J. (2004). Impulsivity, risk-taking and recreational 'ecstasy' (MDMA) use. *Drug and alcohol dependence, 74,* 55-62.

Carver, C. S., & White, T. L. (1994). Behavioural inhibition, behavioural activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*, 319-333.

Casper, R. C., Eckert, E. D., Halmi, D. A., Goldberg, S. C., & Davis, J. M. (1980). Bulimia. Its incidence and clinical importance in patients with Anorexia Nervosa. *Archives of General Psychiatry, 37*, 1030-1035.

Cattell, R. B., Eber, H. W., & Tatsuoka, M. M. (1970). *Handbook for the Sixteen Personality Factor Questionnaire.* Champaign, IL: IPAT.

Charnok, D. J. K. (1989). A comment on the role of dietary restraint in the development of bulimia nervosa. *British Journal of Clinical Psychology, 28*, 329-340.

Cloninger, C. R., Svarik, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50,* 975-990.

Connors, M. E., & Johnson, C. L. (1987). Epidemiology of bulimia and bulimic behaviours. *Addictive Behaviours, 12*, 165-179.

Cooper, P.K., Wood, H. K., Orcutt, H. K., & Albino, A W. (2003). Personality and the predisposition to engage in risky or problem behaviours during adolescence. *Journal of Personality and Social Psychology, 84,* 390-410.

Cortese, S., Isnard, P., Frelut, M. L., Michel, G., Quantin, L., Guedeney, A., et al (2007). Association between symptoms of attention deficit/hyperactivity disorder and bulimic behaviours in a clinical sample of severely obese adolescents. *International Journal of Obesity, 31, 340-346.*

Das, A. K. (1990). Counselling people with addictive behaviour. International *Journal for the Advancement of Counselling, 13*, 169-177.

Dawe, A., & Loxton, N. J. (2004). The role of impulsivity in the development of substance use and eating disorders. *Neuroscience and Biobehavioural Reviews, 28,* 343-351.

Decaluwe, V., & Braet, C. (2003). Prevalence of binge eating disorder in obese children and adolescents seeking weight loss treatment. *International Journal of Obesity, 27,* 404-409.

Department of Health (2005), Specialised Services National Definition Set: 35 Specialised morbid obesity services (all ages). Accessed on 03/03/08 from the worldwide web:

http://www.dh.gov.uk/PolicyAndGuidance/HealthAndSocialCare

Depue, R. A., & Colllins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioural Brain Science, 22,* 491-517.

Eddy, K. T., Novotny, C. M., & Westen, D. (2004). Sexuality, Personality, and Eating Disorders. *Eating Disorders, 12,* 191-208.

Elmore, D. K., & DeCastro, J. M. (1990). Self rated moods and hunger in relation to spontaneous eating behaviour in bulimics, recovered bulimics and normals. *International Journal of Eating Disorders, 9,* 179-190.

Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology, 146,* 348-361.

Eysenck, S. B. J., & Eysenck, H. J. (1977). The place of impulsiveness in a dimensional system of personality description. *British Journal of Social and Clinical Psychology, 16,* 57-68.

Fairburn, C. G., & Brownell, (2002). *Eating Disorders and Obesity: a comprehensive handbook* (pp 171-177). London: Guilford.

Fairburn, C. G. & Cooper, P. J. (1993). Confusion over the core psychopathology of bulimia. *International Journal of Eating Disorders, 13*, 385-389.

Fairburn, C. G., Jones, R., Peveler, R. C., Hope, R. A., & O'Connor, M. (1993). Psychotherapy and bulimia nervosa: The longer-term effects of interpersonal psychotherapy, behaviour therapy and cognitive behaviour therapy. *Archives of General Psychiatry, 50,* 419-428.

Fairburn, C.G., & Walsh, B.T. (2002) Atypical eating disorders (Eating Disorder Not Otherwise Specified). In Fairburn and Brownell (eds) *Eating Disorders and Obesity: a comprehensive handbook* (pg 171-177) London:Guilford.

Fairburn, C. G., & Wilson, T. (1993) *Binge eating: nature and assessment.* London:Guilford

Faunce, G. J. (2002). Eating disorders and attentional disorders: A review. *Eating Disorders, 10,* 125-139.

Favazza, A. R., & Rosenthal, R. J. (1993). Diagnostic issues in self mutilation. *Hospital Community Psychiatry, 44*, 134 – 140.

Garfinkle, P. E., & Garner, D. M. (1982). *Anorexia Nervosa: A Multidimensional Perspective.* New York: Brunner/Mazel.

Garfinkel, P. E., Lin, E., Goering, P., Spegg, C., Goldbloom, D. S., Kennedy, S., et al (1995). Bulimia Nervosa in a Canadian Community Sample: Prevalence and comparison of sub-groups. *American Journal of Psychiatry, 152,* 1052-1058.

Garfinkle, P. E., Moldofsky, H., & Garner, D. M. (1980). The heterogeneity of anorexia nervosa. Bulimia as a distinct subgroup. *Archives of General Psychiatry, 37*, 1036-1040.

Gerbing, D. W., Ahadi, S. A., & Patton, J. H. (1987). Toward a conceptualisation of impulsivity: components across the behavioural and self-report domains. *Multivariate Behavioural Research, 22,* 375-379.

Gormally, J., Black, S., Daston, S., & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviours, 7,* 47-55.

Gottfredson, M., & Hirschi, T. (1990). *A General Theory of Crime.* Stanford, CA; Stanford University Press.

Grau, E., & Ortet, G. (1999). Personality traits and alcohol consumption in a sample of non-alcoholic women. *Personality and Individual Differences, 27,* 1057-1066.

Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behavioural Research Therapy, 8,* 249-266.

Green, L., Fristoe, N., & Myerson, J. (1994). Temporal discounting and preference reversals in choice between delayed outcomes. *Psychonomic Bulletin & Review, 1,* 383-389.

Grilo, C. M., Becker, D. F., Levy, K. N., Walker, M. L., Edell, W. S., & McGlashan, T. H. (1995). Eating disorders with and without substance use disorders. A comparative study of inpatients. *Comprehensive Psychiatry, 36,* 312-317.

Grilo, C. M., & Masheb, G. T. (2001). Subtyping binge eating disorder. *Journal of Consulting and Clinical Psychology, 69,* 1066-1072.

Grisset, N. I., & Fitzgibbon, M. L. (1996). The clinical significance of binge eating in an obese population: Support for BED and questions regarding its criteria. *Addictive Behaviours, 21,* 57-66.

Guerrieri, R., Nederkoorn, C., Stankiewicz, K., Alberts, H., Geschwind, N., Martin, C., et al. (2007). The influence of trait and induced state impulsivity on food intake in normal-weight health women. *Appetite, 49*, 66-73.

Hames, A. L., & Katz, J. L. (1988). Sexual and social maturity versus social conformity in restricting anorectic, bulimic, and borderline women. *International Journal of Eating Disorders, 7*, 331-341

Heatherton, T. F., & Baumeister, R. F. (1991). Binge eating as escape from self-awareness. *Psychological Bulletin, 110*, 86-108.

Helmers, K. F., Young, S. N., & Pihl, R. O. (1995). Assessment of measures of impulsivity in healthy male volunteers. *Personality and Individual Differences, 19*, 927- 935.

Herman, C. P., & Polivy, J. (1980). Restrained eating. In A. B. Stunkard (Ed.). Obesity. Saunders, Philadelphia.

Higuchi, S., Suzuki, K., Yamada, K., Parrish, K., & Kono, H. (1993). Alcoholics with eating disorders: Prevalence and clinical course. A study from Japan. *British Journal of Psychiatry, 162*, 403-406.

Holderness, C. C., Brooks-Gunn, J., & Warren, M. P. (1994). Co-morbidity of eating disorders and substance abuse: Review of the literature. *International Journal of Eating Disorders, 16*, 1-34.

Holtkamp, K., Konrad, K., Muller, B., Heussen, N., Herpertz, S., Herpertz-Dahlmann, B, et al. (2004). Overweight and obesity in children with attention deficit/hyperactivity disorder. *International Journal of Obesity, 28*, 685-689.

Hoyle, R. H., Fejfar, M. C., & Miller, J. D. (2000). Personality and sexual risk-taking: A quantitative review. *Journal of Personality, 68*, 1203-1231.

Hsu, L. K. G. (1996). Epidemiology of the eating disorders. *Psychiatric Clinics of North America, 19,* 681-700.

Hu, F. B. (2003). Overweight and obesity in women: Health risks and consequences. *Journal of Women's Health, 12,* 63-172.

Irving, L., McClusky-Fawcett, K., & Thissen, D. (1990). Sexual attitudes and behaviour of bulimic women. A preliminary investigation. *Journal of Youth and Adolescence, 19,* 395-411.

Jessor, R., Graves, T. D., Hanson, R. C., & Jessor, S. L. (1968). *Society, personality, and deviant behaviour: A study of a tri-ethnic community.* NY: Holt, Rinehart, & Winston.

Jessor , R., & Jessor, S. L. (1977). *Problem Behaviour and Psychosocial Development: A Longitudinal Study of Youth.* New York: Academic Press.

Johnson, W. G., Boutelle, K. N., Torgrud, L., Davig, J. P., & Turner, S. (2000). What is a binge? The influence of amount, duration and loss of control criteria on judgements of binge eating. *International Journal of Eating Disorders, 27,* 471-479.

Johnson, W. G., Carr-Nangle, R. E., Nangle, D. W., Antony, M. M., & Zayfert, C. (1997). What is binge eating? A comparison of binge eater, peer and professional judgements of eating episodes. *Addictive Behaviours, 22,* 631-635.

Johnson, C. L., & Larson, P. (1982). Bulimia: An analysis of moods and behaviour. *Psychosomatic Medicine, 44,* 341-351.

Johnson, W. G., Robertson-Nay, R., Rohan, K. J., & Torgrud, L. (2003). An experimental investigation of DSM-IV binge eating criteria. *Eating Behaviours, 4*, 295-303.

Johnson, C., Tobin, D. L., & Dennis, A. (1990). Differences in treatment outcome between borderline and non-borderline bulimics at one year follow-up. *International Journal of Eating Disorders, 9*, 617-627.

Johnson-Sabine, E. C., Wood, K. H., & Wakeling, A. (1984). Mood changes in bulimia nervosa. *British Journal of Psychiatry, 145,* 512-516.

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology, 71*, 17-24.

Kaltiala-Heino, R., Rissanen, A., Rimpelae, M., & Rantanen, P. (2003). Bulimia and impulsive behaviour in middle adolescence. *Psychotherapy Psychosomatics, 72*, 26-33.

Kane, T., Loxton, N. J., Staiger, P., & Dawe, S. (2004). Does the tendency to act impulsively underlie binge eating and alcohol use problems? An empirical investigation. *Personality and Individual Differences, 36,* 83-94.

Kaye, W. H. (1994). Vulnerability to substance abuse in eating disorders. *Comprehensive Psychiatry, 35*, 185-190.

Keel, P., & Mitchell, J. E. (1997). Outcome in bulimia nervosa. *American Journal of Psychiatry, 154*, 313-321.

Kendler, K. S., MacClean, C., Neale, M., Kessler, R. D., Heath, A. C., & Eaves, L. (1991). The genetic epidemiology of bulimia nervosa. *American Journal of Psychiatry, 148,* 1627-1637.

Kessler, R. C., McGonagle, K. A., Zhag, S., Nelson, C. B., Hughes, M., Eshleman, S., et al (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric

disorders in the United States: Results from the National Co-morbidity Survey. *Archives of General Psychiatry, 51,* 8-19.

Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology General, 128,* 78-87.

Kollins, S. H. (2003). Delay discounting is associated with substance use in college students. *Addictive Behaviours, 28,* 1167-1173.

Lacey J. H. (1982). The bulimia syndrome at normal body weight: Reflections on pathogenesis and clinical features. *International Journal of Eating Disorders, 2,* 59-66

Lacey, J. H., & Evans, C. D. H. (1986). The impulsivist: a multi-impulsive personality disorder. *British Journal of Addiction, 81,* 641-649.

Lane, S. D., Cherek, D. R., Rhodes, H. M., Pietras, C. J., & Tcheremissine, O. V (2003). Relationships among laboratory and psychometric measures of impulsivity: Implications in substance abuse and dependence. Addictive Disorders & their Treatment, 2, 33-40.

Latner, J. D., & Clyne, C. (2008). The diagnostic validity of the criteria for binge eating disorder. *International Journal of Eating Disorders, 41,* 1-14.

Latner, J. D., Hildebrandt, T., Rosewall, J. K., Chisholm, A. M., & Hayashi, K. (2007). Loss of control over eating reflects eating disturbances and general psychopathology. Behaviour and Research Therapy, 45, 2203-2211.

Lavik, N. J., Clausen, S. E., & Pedersen, W. (1991). Eating behaviour, drug use, psychopathology and parental bonding in adolescents in Norway. *Acta Psychiatrica Scandinavica, 84,* 387-390.

Lilenfeld, L., & Kaye, W. (1996). The link between alcoholism and eating disorders. *Alcohol, Health and Research World, 20,* 94-102.

Lilenfeld, L. R., Kaye, W. H., & Greeno, C. G. (1997). Psychiatric disorders in women with bulimia nervosa and their first-degree relatives: effects of co-morbid substance dependence. *International Journal of Eating Disorders, 22,* 253-264.

Linehan, M. M. (1993). *Cognitive behavioural treatment of borderline personality disorder.* New York, NY: The Guilford Press.

Loro, A. D., & Orleans, C. S. (1981). Binge eating in obesity: Preliminary findings and guidelines for behavioural analysis and treatment. *Addictive Behaviours, 6,* 155-166.

Loxton, N. J., & Dawe, S. (2001). Alcohol abuse and dysfunctional eating in adolescent girls: the influence of individual differences in sensitivity to reward and punishment. *International Journal of Eating Disorders, 29,* 455-462.

Marcus, M., Wing, R., & Hopkins, J. (1988). Obese binge eaters: affect, cognitions, and response to behavioural weight control. *Journal of Consulting and Clinical Psychology, 56,* 433-439.

McClelland, L., Mynors-Wallis, L., Fahy, T., & Treasure, J. (1991). Sexual abuse, disordered personality and eating disorders. *British Journal of Psychiatry, 158,* 63-68.

Milos, G., Spindler, A., & Buddeberg, C. (2003). Axis I and II co-morbidity and treatment experiences in eating disordered subjects. *Psychotherapy and Psychosomatics, 72,* 276-285.

Mischel, W. (1984). Convergences and challenges in the search for consistency. *American Psychologist, 39*, 351-364.

Mitchell, S. H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology, 146*, 455-464.

Mitchell, J. E., Pyle, R. L., Pomeroy, C., Zollman, M., Crosby, R., Sein, H., et al (1993). Cognitive behavioural group psychotherapy of bulimia nervosa: importance of logistical variables. *International Journal of Eating Disorders, 14*, 277-287.

Monterosso, J., & Ainslee, G. (1999). Beyond discounting: possible experimental models of impulse control. *Psychopharmacology, 146*, 339-347.

Monterosso, J., Ehrman, R., Napier, K. L., O'Brien, C. P., & Childress, A. R. (2001). Three decision-making tasks in cocaine-dependent patients: Do they measure the same construct? *Addiction, 96*, 1825-1837.

Morgan, M. G. (1998). Uncertainty analysis in risk assessment. *Human and Ecological Risk Assessment, 4*, 25-39.

Nagata, T., Kawarada, Y., Kiriike, N., & Iketani, T. (2000). Multi-impulsivity of Japanese patients with eating disorders: primary and secondary impulsivity. *Psychiatric Research, 94*, 239-250.

Nasser, J. A., Gluck, M. E., & Geliebter, A. (2004). Impulsivity and test meal intake in obese binge-eating women. *Appetite, 43*, 303-307.

Newman, J. P., Patterson, C. M., & Kosson, D. S. (1987). Response perseveration in psychopaths. *Journal of Abnormal Psychology, 96*, 145-148.

Newman, J. P., Patterson, E. W., Howland, E. W., & Nichols, S. L. (1990). Passive avoidance in psychopaths: The effects of reward. *Personality and Individual Differences, 11*, 1101-1114.

Ogden, J. (2003). *The psychology of eating: from healthy to disordered behaviour.* Oxford: Blackwell.

Ouwens, M. A., Van Strien, T., & Van der Staak, C. P. F. (2003). Absence of a disinhibition effect of alcohol on food consumption. *Eating Behaviours, 4,* 323-332.

Palme, G., & Palme, J. (1999). Personality characteristics of females seeking treatment for obesity, bulimia nervosa, and alcoholic disorders. *Personality and Individual Differences, 26,* 255-263.

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology, 51,* 768-774.

Paul, T., Schroeter, K., Dahme, B., & Nutzinger, D. O. (2002). Self injurious behaviour in women with eating disorders. *American Journal of Psychiatry, 159,* 408-411.

Penas-Liedo, E., & Waller, G. (1999). Bulimic psychopathology and impulsive behaviours among non-clinical women. *International journal of eating disorders, 29,* 71-75.

Petry, N. M. (2001). Substance abuse, pathological gambling, and impulsivity. *Drug and Alcohol Dependence, 63,* 29-38.

Petry, N. M. (2002). Discounting of delayed rewards in substance abusers: Relationship to antisocial personality disorder. *Psychopharmacology, 162,* 425-432.

Petry, N. M., & Casarella, T. (1999). Excessive discounting of delayed rewards in substance abusers with gambling problems. *Drug and Alcohol Dependence, 56*, 25-32.

Pope, H., Frankenburg, F., Hudson, J., Jonas, J., & Yurgelun-Todd, D. (1987). Is bulimia associated with BPD? A controlled study. *Journal of Clinical Psychiatry, 48*, 181-184.

Powell, J. H., Al-Adawi, S., Morgan, J., & Greenwood, R. J. (1996). Motivational deficits after brain injury: effects of bromocriptine in 11 patients. *Journal of Neurology, Neurosurgery and Psychiatry, 60,* 416-421.

Pratt, E. M., Niego, S. H., & Agras, W. S. (1998). Does the size of a binge matter? *International Journal of Eating Disorders, 24*, 307-312.

Pryor, T. (1995). Diagnostic criteria for eating disorders: DSM-IV revisions. *Psychiatric Annals, 25*, 40-45.

Pyle, R. L., Mitchell, J. E., & Eckert, E. D. (1981). Bulimia: a report of 34 cases. *Journal of Clinical Psychiatry, 42*, 60-64.

Rachlin, H., Raineri, A., & Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behaviour, 55*, 233-244.

Rodin, J. (1978), Has the distinction between internal versus external control of feeding outlived its usefulness? In: G.A. Bray, Editor, *Recent advances in obesity research: II. Proceedings of the 2nd International Congress on Obesity*, John Libbey and Co., London.

Rodin, J. (1981). Current status of the internal–external hypothesis for obesity. *American Psychologist 36*, 361–372.

Rodriguez, M., Mischel, W., & Shoda, Y. (1989). Cognitive person variables in the delay of gratification of older children at-risk. *Journal of Personality and Social Psychology, 57*, 358-367.

Rosenvinge, J., Martinussen, M., & Ostensen, E. (2000). The co-morbidity of eating disorders and personality disorders: A meta-analytic review of studies published between 1983 and 1998. *Eating and Weight Disorders, 5*, 52-61.

Ross, H. E., & Ivis, F. (1999) Binge Eating and Substance Use Among Male and Female Adolescents. *International Journal of Eating Disorders 26,* 245-260.

Rossiter, E. M., & Agras, W. S. (1990). An empirical test of the DSM-II-R definition of binge. *International Journal of Eating Disorders, 9*, 513-518.

Rossiter, E. M., Agras, W. S., Telch, C. F., & Schneider, J. A. (1993). Cluster B personality characteristics predict outcome in treatment of bulimia nervosa. *International Journal of Eating Disorders, 13,* 349-357.

Rothschild, B. S., Fagan, P. J., Woodall, C., & Anderson, A. E. (1991). Sexual functioning of female eating disordered patients. *International Journal of Eating Disorders, 10,* 389-394.

Rubia, K., Oosterlaan, J., & Sergeant, J. A. (1998). Inhibitory dysfunction in hyperactive boys. *Behavioural Brain Research, 94*, 25-32.

Ruderman, A. J. (1986). Dietary restraint: A theoretical and empirical review. *Psychological Bulletin, 99*, 247–262.

Ruderman, A. J., & Besbeas, M. (1992). Psychological characteristics of dieters and bulimics. *Journal of Abnormal Psychology, 101*, 383–390.

Ruderman, A. J., & Wilson, G. T. (1979). Weight, restraint, cognitions and counter-regulation. *Behavioural Research Therapy, 17*, 581-590.

Sansone, R. A., Wiederman, M. W., & Sansone, L. A. (2000). The prevalence of borderline personality disorder among individuals with obesity: a critical review of the literature. *Eating Behaviours, 1*, 93-104.

Schachter, S., Goldman, R., & Gordon, A. (1968). Effects of fear, food deprivation and obesity on eating. *Journal of Personality and Social Psychology, 10*, 91–97.

Spencer, J. A., & Fremoux, W. J. (1979). Binge eating as a function of restraint and weight classification. *Journal of Abnormal Psychology, 88*, 262-267.

Steiger, H., & Stotland, S. (1996). Prospective study of outcome in bulimics as a function of Axis II co-morbidity: long term responses on eating and psychiatric symptoms. *International Journal of Eating Disorders, 20*, 149-161.

Stice, E. (1998). Modelling of eating pathology and social reinforcement of the thin ideal predict onset of bulimic symptoms. *Behaviour Research and Therapy, 36*, 931-944.

Stice, E., Agras, W. S., Telch, C. F., Halmi, K. A., Mitchell, J. E., & Wilson, T. (2001). Subtyping binge eating disordered women along dieting and negative affect dimensions. *International Journal of Eating Disorders, 30,* 11-27.

Stickney, M. I., Miltenberger, R. G., & Wolff, G. (1999). A descriptive analysis of factors contributing to binge eating. *Journal of Behavioural Therapies, 30,* 117-189.

Strober, M., Freeman, R., Bower S., & Rigali, J. (1996). Binge eating in anorexia nervosa predicts later onset of substance abuse disorder. *Journal of Youth and Adolescence, 25*, 519-525.

Sunday, S., Levey, C., Halmi, K. (1993). Effects of depression and borderline personality traits on psychological state and eating disorder symptomotology. *Comprehensive Psychiatry, 34*, 70-74.

Telch, C. F., & Agras, W. S. (1996). Do emotional states influence binge eating in the obese? *International Journal of Eating Disorders, 20*, 271-279.

Tellegen, A. (1982). *Brief manual for the Multidimensional Personality Questionnaire.* University of Minnesota. Unpublished manuscript.

Vandereycken, W. (1990). The addiction model in eating disorders: Some critical remarks and a selected bibliography. *International Journal of Eating Disorders, 9,* 95-101.

Van Strien, T., Cleven, A., & Schippers, G. (2000), Restraint, tendency toward overeating and ice cream consumption. *International Journal of Eating Disorders,* 28, 333–338.

Vitaro, F., Arseneault, L., & Tremblay, R. E. (1999). Impulsivity predicts problem gambling in low SES adolescent males. *Addiction, 94*, 565-575.

Wade, C., & Tavris, C. (2000). *Psychology (6^{th} ed.).* Upper Saddle River, NJ: Prentice-Hall.

Westenhoefer, J., Broeckman, P., Münch, A. K. & Pudel, V. (1994). Cognitive control of eating behaviour and the disinhibition effect. *Appetite, 23,* 27–41.

Weston, D., & Harnden-Fisher, J. (2001). Personality profiles in eating disorders: Rethinking the distinction between Axis I and Axis II. *American Journal of Psychiatry, 158*, 547-562.

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669-689.

Wiederman, M. (1996). Women, Sex and Food: A review of research on eating disorders and sexuality. *The Journal of Sex Research, 33*, 301-311.

Wiederman, M., Pryor, T., & Morgan, C. D. (1996). Women, Sex and Food: A review of research on eating disorders and sexuality. *The Journal of Sex Research, 33*, 301-311.

Wilson, G. T. (1976). Obesity, binge eating, and behaviour therapy: some clinical observations. *Behaviour Therapy, 7,* 700-701.

Wilson, G. T. (1992). Behavioural treatment of childhood obesity: theoretical and practical implications. *American Journal of Clinical Nutrition, 55*, 818-822.

Wolfe, W. L., & Maisto, S. A. (2000). The relationship between eating disorders and substance use: moving beyond co-prevalence research. *Clinical Psychology Review, 20*, 617-631.

Wonderlich, S. A., Connolly, K. M., & Stice, E. (2004). Impulsivity as a risk factor for eating disorder behaviour: Assessment implications with adolescents. *International Journal of Eating Disorders, 36,* 172-182.

Wonderlich, S. A., Crosby, R. C., Smyth, J., Miltenberger, R., & Mitchell, J. E. (2003). Personality traits and emotional states in bulimic behaviour: An intensive monitoring study. Paper presented at the Eating Disorder Research Society Annual Meeting, Ravello, Italy.

Wonderlich, S. A., Swift, W. J., Slomik, H. B., & Goodman, S. (1990). DSM-III-R personality disorders in eating-disorder subtypes. *International Journal of Eating Disorders, 9*, 607-616.

World Health Organisation. (2003). Global Strategy on Diet, Physical Activity and Health. Geneva, Switzerland: World Health Organisation.

Yager , J., Landsverk, J., Edelstein, C. K., & Jarvik, M. (1988). A 20-month follow up study of 628 women with eating disorders: Course of associated symptoms and related clinical features. *International Journal of Eating Disorders, 7*, 503-513.

Zeeck, A., Birindelli, E., Sandholz, A., Joos, A., Herzog, T., & Hartmann, A. (2007). Symptom severity and treatment course of bulimic patients with and without a borderline personality disorder. *European Eating Disorders Review, 15*, 430-438.

Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal.* Hillsdale, NJ: Erlbaum.

Zuckerman, M. (1994). *Behavioural expressions and biosocial bases of sensation seeking.* Cambridge University Press: New York.

EMPIRICAL PAPER

Binge Eating is associated with Impulsivity in a Delay Discounting Procedure

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(see Appendix B for Instructions to Authors)

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Abstract

The present study examined the relationship between impulsivity and binge eating behaviour, and evaluated a model of relapse based on Mazur's delay discounting formula (Mazur, 1987). Two distinct eating disordered groups were identified using the Binge Eating Scale. Twenty binge eaters and twenty controls completed a delay-discounting task, the Barrett Impulsivity Scale (BIS), the Behavioural Inhibition/Activation Scale (BIS/BAS), and the Adult ADHD Scale (ASRS). The two groups were significantly different as identified by the self-report measures of impulsivity. Results demonstrated that the rate of discounting was significantly different between the two groups but impulsivity scores on the delay-discounting task do not correlate with the BIS or the BIS/BAS supporting previous research identifying low correlations between self-report and behavioural measures of impulsivity. An evaluation of the utility of the delay-discounting task as a model of relapse was inconclusive but supports the need for future research to elucidate the role of delay-discounting in predicting future behaviour.

Keywords: binge-eating, binge-eating disorder, bulimia, impulsivity, impulse dysregulation

INTRODUCTION

Binge eating is a significant public health issue and a primary cause of widespread obesity in the US and Europe. In attempting to better understand and therefore, improve the assessment, prevention and treatment of this disorder, researchers have considered the role of impulsivity. Indeed, impulsivity has consistently been shown to be a biologically-based, heritable characteristic with emergent psychological properties linked to the development and maintenance of binge eating (DeZwaan, Mitchell, Seim, Specker, Pyle, Raymond et al, 1994; Keel, Mitchell, Miller, Davis, & Crow, 2000; Vervaet, Van Heeringen & Audengert, 2004). Impulsivity as measured on trait-based self-report questionnaires is generally elevated in binge eaters. For example, in a series of studies using self-report measures of impulsivity, binge eaters showed higher impulsivity scores compared to restrictive eaters (Claes, Vandereycken & Vertommen, 2002; Fassino, Abbate Daga, Amianto, Leombruni, Boggio & Rovera, 2002;Vervaet et al, 2004) and controls (Gluck, Geliebter, Hung & Yahav, 2004; Kane, Loxton, Staiger & Dawe, 2004).

Methodological difficulties in measuring impulsivity

Impulsivity, however, is a multidimensional construct (Gerbing, Ahadi & Patton, 1987) and research has only just begun to identify the various types of impulsivity implicated in binge eating. In spite of the fact that impulsivity, measured in a variety of different formats, has shown a strong correlation with binge eating, most research regarding impulsivity in binge eaters has been studied using self-report and personality trait measures such as the Barrett Impulsivity Scale (BIS-II, Patton, Stanford & Barrett, 1995), the Behavioural Inhibition/Activation Scale (BIS/BAS; Carver & White, 1994), the Impulsivity Rating Scale (IRS; Lecrubier, Braconnier,

Said & Payan, 1995), and the Impulsive Behaviours Scale (IBS; Whiteside & Lynam, 2001).

Such self-report measures, although often correlated, do not provide uniformly consistent results. Gerbing et al (1987) investigated the components underlying items from a comprehensive but diverse domain of self-report impulsivity measures – the 16PF Impulsivity Scale, the Guilford-Zimmerman Restraint Scale (GZRZ), the PRF Impulsivity Scale, the Barratt Impulsivity Scale (BIS), the Eysenck I-7 Impulsivity Scale (I7), the Sensation Seeking Scale (SSS), and the Minnesota Multiphasic Personality Inventory (MMPI). Using factor analyses, they identified that, although some of the self-report components correlated moderately, each component was identified as being distinct. In a longitudinal study, Wonderlich, Connolly and Stice (2004) measured impulsivity in 218 female high school students, using an adapted form of the Disinhibition Scale from the self-report General Temperament Survey (Watson & Clark, 1993) to determine whether impulsivity serves as a risk factor for eating disordered behaviour and to examine whether different risk outcomes are obtained depending on the assessment strategy used to measure impulsivity. This study identified that impulsivity, when measured with traditional self-report personality scales, failed to predict the onset of eating disordered behaviour. However, when behavioural constructs associated with impulsivity (i.e. delinquency, substance abuse) were examined, they significantly predicted the onset of eating disordered behaviour. They concluded that eating pathology aligns itself only with certain components of impulsivity. Unlike measures of anxiety and depression, which appear to tap a single construct, self-report measures of impulsivity assess a number of related domains. This is further illustrated by drawing attention to the number of subscales provided by each impulsivity measure. Although some measures, such as

the 16PF and the PRF provide a single impulsivity score, the Sensation Seeking Scale, the Barrett Impulsivity Scale and the I7 explicitly define impulsivity as a multi-dimensional construct by providing distinct subscales. Such disparity in providing estimates of the construct of impulsivity attests to the lack of a coherent framework from which to conceptualise it. Furthermore, as with all self-report measures, consideration needs to be given to the validity of the responses, particularly the question as to the ability of participants with impulsivity problems to assess their own cognitive functions (Evenden, 1999). Given the importance of recognising and measuring impulsivity as a multi-dimensional construct, it is disconcerting that researchers typically do not cross modalities of measurements (e.g. behavioural laboratory as well as self-report assessments) and that relatively few behavioural studies investigating impulsivity exist. The behavioural studies that do exist incorporate such tasks as the Card Arranging Reward Responsiveness Objective Test (CARROT; Powell, Al-Adawi, Morgan & Greenwood, 1996), and the GO/NO GO task (Newman, Patterson, Howland, & Nichols, 1990). The CARROT is a task designed to measure reward reactivity, i.e. the increase in speed on a simple card-sorting task in response to a financial reward and the GO/NO GO task is a computerised measure of impulsivity where participants must attempt to execute or inhibit their responses depending on whether a 'GO' or 'NO GO' stimulus appears on the screen. Although both measures appear to be an ecologically valid measure of a specific dimension of impulsivity, they involve a reaction-time component and an error rate component, which may bias the response of anxiety sufferers (a relatively apparent co-morbid symptom of binge eating and eating disordered individuals).

The Delay Discounting Task

One objective behavioural approach to understanding impulsive choice is the analysis of delay discounting (Green, Fry & Myerson, 1994), a measure of how people make trade-offs between larger, delayed rewards, and more immediate, smaller rewards. Delay discounting equates impulsivity with the person's tendency to choose the more immediate of the alternatives and, in so doing, decrease the reward he/she receives. The discount rate of an individual can be measured using a delay adjusting procedure (Ainslee, 1992; Green & Myerson, 1993; Logue, 1988; Petry & Casarella, 1999) whereby choices are offered to individuals as to their preference between either an immediate, small reward, or a larger, delayed reward. In the Petry and Casarella (1999) study, delay discounting functions of substance abusing problem gamblers and controls were evaluated. Participants were asked to choose between hypothetical monetary amounts available immediately, or after various delays (6 hours, 1 day, 1 week, 2 months, 6 months, 1 year, 5 years or 25 years). For example, in one condition, a $1000 reward was delayed at intervals ranging from 6 hours to 25 years, and at each delay interval, the immediately available reward varied from $1 to $999. Throughout the presentation of choices, the delay associated with the larger/later reward was changed to determine the exact amount of delay necessary to make the larger alternative equally preferred to the more immediate alternative. If the participant repeatedly chose the smaller, more immediate reward, the delay to the larger reward was decreased. When a criterion of stability was reached, such that neither choice was clearly preferred, an indifference point was identified. From an array of indifference points, the discount rate (the *k* value) of each individual was calculated, with a high *k* value representative of an impulsive individual and a low *k* value, representative of a more self-controlled individual. Within this study,

substance-abusing problem gamblers were identified as discounting delayed rewards at significantly higher rates than controls.

The rate at which the value of a reward is discounted, as a function of delay to its delivery, is best described by a hyperbolic formula developed by Mazur (1987). This formula consistently fits empirically approximated indifference points for multiple delays and the single subject-specific *k* value has been found to discriminate addicts from controls for a range of addictions.

$$v_d = V/(1 + kd)$$

(Equation 1)

In this well-established formula, v_d is the current subjective value of the reward adjusted for the delay in its delivery, V is the value of the reward delivered immediately, d is the delay duration, and k is an empirically-derived constant proportional to the degree of delay discounting. The higher the k value, the more rapidly the value of a reward decreases with delay to its delivery. This hyperbolic formula has been shown to describe accurately, the behaviours of humans choosing real and hypothetical monetary outcomes and can be used as a reliable measure of deviance from predicted 'normal' behaviour (Green, Fristoe & Myerson, 1994; Myerson & Green, 1995; Rachlin, Raineri & Cross, 1991).

Mazur's (1987) discounting formula has successfully differentiated, in the predicted direction, many populations thought to differ in impulsiveness. Delay discounting procedures have found that children are more impulsive than adults (Green et al, 1994; Green, Elliman & Rogers, 1996), males are more impulsive than females (Kirby & Marakovic, 1995), and pathological gamblers (Alessi & Petry,

2003; Petry, 2001) and various drug-dependent populations (Bickel & Marsch, 2001) are more impulsive than controls. Different delay discounting rates have also been observed in clinical populations when DSM-IV diagnoses were used as predictors of impulsive behaviour. For example, Crean, DeWit and Richards (2000) utilised a computerised delay-discounting task with 24 psychiatric outpatients considered either at a high risk (those participants with diagnoses of substance dependence and abuse, borderline personality disorder and bi-polar disorder) or low risk (those participants with mood and/or anxiety disorders) for engaging in impulsive behaviour depending on their psychiatric diagnoses. Participants were presented with a series of approximately 100 choice trials consisting of choices between immediate and delayed monetary rewards, i.e. $5 immediately or $10 in 30 days. The programme narrowed the range of values over successive trials to obtain indifference points for each participant. To determine the overall rate of discounting for delay, the hyperbolic equation was fit to five indifference points for each participant. Results identified that the high-risk participants exhibited significantly greater delay discounting than the low-risk group.

However, although binge eating has been characterised as a problem of impulsivity, no studies have tested the applicability of the delay discounting procedure with binge eaters. A high delay-discounting rate may explain binge eaters' persistent choice to overeat despite the long-term consequences, i.e. binge-eaters persistently choose the relatively immediate and short-term rewards of overeating (pleasant feelings, euphoria, satiety) over a variety of delayed larger rewards (healthier lifestyle). This concept highlights why it is implicit, in voluntary participation in healthy eating regimes/programmes, that overeaters need to value the long term rewards of healthy eating over the short term rewards that maintain their

bingeing. However, many binge eaters, with the best of intentions of sticking to a healthy eating regime, persist in overeating and express regret over their choices.

Preference Reversals

As well as being a well-validated behavioural measurement of impulsivity, the delay-discounting framework has also been used to understand the phenomena of relapse in dependent individuals who, like binge eaters, are also believed to suffer from a general ongoing pattern of impulsive choices. Whilst impulsivity is defined as the selection of a smaller, more immediate reward over a larger more delayed reward, the relapse (or "loss of control") phenomena is demonstrated by participants making a preference reversal. For example, at sufficient delays to both rewards, a person may initially prefer the larger, later reward but, as both rewards approach in time, preference may reverse, such that the person temporarily prefers the smaller reward (see Figure 3). Figure 3 shows the value of two rewards plotted as a function of time to those rewards. One reward is a sooner smaller magnitude reward, and the other a delayed, larger-magnitude reward with the rewards separated in time. The two curves indicate the present value of the rewards as a function of time to their availability. At time point 1, the larger/later reward has greater value to a participant than the smaller/sooner reward (e.g. self-controlled choice). However, as the smaller/sooner reward becomes more immediately available (as at time point 2) the value of the rewards reverse and the smaller/sooner reward has greater value to the participant (i.e. impulsive choice). This reversal of preference occurs even though the objective magnitude of the rewards and the time between their availability remains constant.

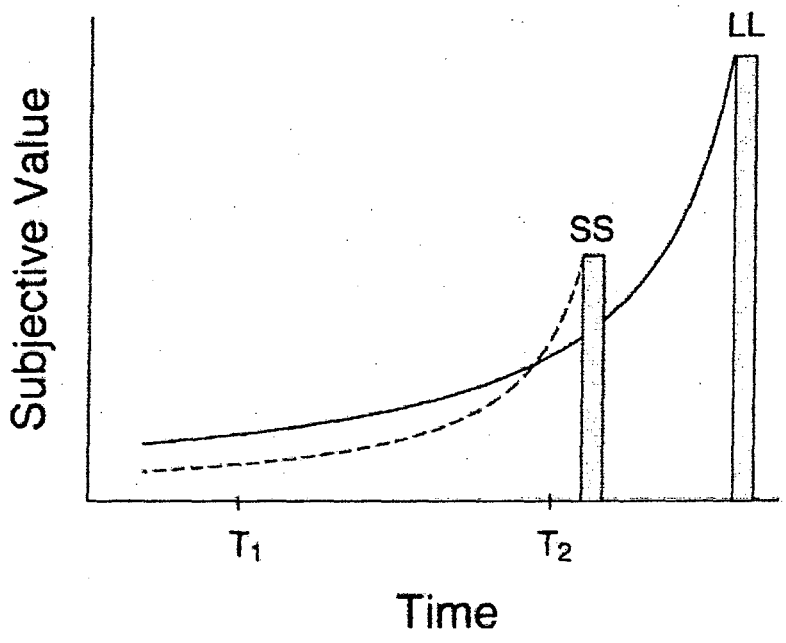


Figure 3. Choice between a smaller reward, available sooner (SS), and a larger reward, available later (LL). The curved lines represent change in subjective value as a function of time. The heights of the bars represent the actual reward amounts. T_1 = Time 1; T_2 = Time 2.

In Figure 3, the vertical axis represents the subjective, or discounted, value of a future reward, and the horizontal axis represents time. The heights of the bars represent the actual reward amounts. The curves show how their subjective values might change as a function of the time at which the rewards were evaluated. Such curves are termed *discounting functions* because they indicate how the value of a future reward is discounted when it is delayed. By using Mazur's (1987) hyperbolic formula, researchers have been able to produce substantially better fits to choices among delayed rewards and, as such, the delay-discounting task enables researchers to compare the estimated parameters of impulsivity (i.e. *k* values) to individual patterns of responding. Individuals adopt this hyperbolic formula to such an extent

that the hyperbolic curve derived from the formula, is assumed to depict, not only the normatively rational discount rate, but also the one that people follow spontaneously. The hyperbolic discounting curve gives preference a property, which most people demonstrate regularly in making choices between different modalities of reward, (i.e. food, relief from noxious noise, money) and it depicts an elementary property of a participant's response to reward.

According to Figure 3, if one were offered a choice between the smaller, sooner and the larger, later rewards at Time 1, one would choose the larger, later reward, whereas if one were offered a choice between the same rewards at Time 2, one would choose the smaller, sooner reward.

Binge eaters, for example, may choose not to have dessert before going to a restaurant (*self-controlled* choice) but when the time comes closer to having dessert, they may give in to the temptation (*preference reversal*) and order it after all, only to regret having eaten it after the meal is over. Empirical studies have found evidence that preference reversals occur for a range of reinforcers, such as hypothetical monetary rewards (Kirby & Herrnstein, 1995), drugs of dependence (Ainslee & Haendel, 1983, cited in Ainslee, 1992), durations of playing video games (Millar & Navarick, 1984) and durations of turning off a noxious noise (Navarick, 1982). Previous research using real rewards has also shown that people's preferences typically do reverse with changes in delay (Kirby & Herrnstein, 1995).

An increase in the use of delay discounting tasks to measure impulsivity and preference reversals has been applied to many topics of psychological concern, such as gambling (Alessi & Petry, 2003), substance abuse (Madden, Petry, Badger & Bickel, 1997), alcohol abuse (Vuchinich & Simpson, 1998); and smoking (Bickel, Odum & Madden, 1999). Although delay discounting appears related to other issues

of appetitive dependence, it has not, to the researcher's knowledge, been studied in eating disordered individuals. Discounting by binge eaters may be important to examine because, although binge eaters typically do not experience major disruptions in their life status as a result of their problem (e.g. homelessness, loss of employment) unlike extreme dependency on heroin or alcohol, nonetheless, they do experience recurrent and significant difficulties.

As much previous research has focussed on the use of self-report measures in the eating disorders field, data supporting the use of delay discounting with the binge-eating population needs to be validated. Behavioural tasks may fall short of simulating real-life decision-making, but they represent a significant development in determining the convergent validity of self-reported measures of traits such as impulsivity.

The benefits of using a delay-discounting task to measure impulsivity

Indeed, the advantages of using a delay-discounting task to measure impulsivity (as opposed to self-report questionnaires), within a wide array of impulse dysregulation disorders, are vast. It provides a precise, quantitative approach for studying behaviour in a laboratory and it is a valid measure of impulsivity. Furthermore, it follows logical mathematical models that reliably predict and quantify choice behaviours in humans and non-humans (the ability to study behavioural processes across species represents a powerful research tool); it can be used, not only as a measure, but also as a predictor. The use of experimental cognitive tasks are less transparent than those of widely-used self-report inventories and, importantly, the delay discounting task does not include a latency or error-rate component but is a pure measure of reward sensitivity. Furthermore, laboratory studies have a methodological

advantage over the use of self-report inventories in that the interpretation of cognitive processing is based on overt behaviour in response to controlled laboratory stimuli as opposed to retrospective self-report. Indeed, Green & Myerson (2004) discuss the value of studying choice involving both delayed and probabilistic outcomes, using a discounting task framework and Navarick (2004) posits that combining reinforcement with questions about future reinforcers could facilitate the integration of questionnaire research into a behavioural framework.

Previous researchers typically have not crossed modalities of measurement for behavioural and self-report assessments which makes it difficult to interpret the generalisability of results across different dimensions of impulsivity or understand how specific components of impulsivity are related to binge eating. This research has compared a behavioural measure of impulsivity (delay discounting) to two self-report measures of impulsivity (the BIS/BAS and the BIS).

The current investigation was an innovative approach intended to further the behavioural study of impulsivity in binge eating behaviours by using a delay discounting task. The delay-discounting task was used to assess a specific behavioural definition of impulsivity in relation to choices about *real*[3] amounts of money. Four specific hypotheses have been derived from Mazur's (1987) theoretical model of delay discounting and from the empirical literature reviewed above. First, the research aimed to identify that the behaviour of this sample will be well described by Mazur's hyperbolic formula, allowing further comparisons to be made. Second, the research aimed to identify whether binge eaters would display significantly higher levels of impulsivity on the delay discounting task than control participants, in

[3] Kirby (1997) noted that studies using real rewards reported steeper discounting rates than those studies using hypothetical rewards, although other studies support the idea that discounting of real and hypothetical rewards is at least qualitatively similar (Baker, Johnson, & Bickel, 2003; Camerer & Hogarth, 1999; Frederick, Loewenstein & O'Donaghue, 2002; Johnson & Bickel, 2001; Madden, Begotka, Raiff & Kastern, 2003).

support of previous studies. Third, the research aimed to assess whether the delay discounting tasks would correlate with other self-report measures of impulsivity in an attempt to establish convergent validity between behavioural and self-report measures of impulsivity. Finally, the research addressed the issue of preference reversal and aimed to identify whether the delay-discounting model could be used to understand the relapse (loss of control) phenomenon in binge eating behaviour.

MATERIALS & METHOD

Participants

The Binge Eating Scale (BES; Gormally, Black, Daston & Rardin, 1982) was used to screen 244 students from the University of Southampton. The twenty highest-scoring individuals (binge eating group) and the twenty lowest-scoring individuals (control group) were invited by email to participate in the experiment (< 17 = mild or no binge eating problem; 18-26 = moderate binge eating problem; >27 = severe binge eating problem). Forty participants took part in the study for course credit and a financial reward based on their responses given in the task. Groups were matched by gender such that the binge-eating group consisted of 18 females and 2 males (mean BES score = 23.90, SD = 3.08, mean age = 22.60 years, SD = 7.41) and the control group consisted of 18 females and 2 males (mean BES score = 2.25, SD = 2.22, mean age = 20.50, SD = 5.43) with no significant difference in age ($t_{(38)} = 1.02$, $p = .313$). The Adult ADHD self report scale (ASRS; Adler, Kessler & Spencer, 2003) was used as a screening process, designed to exclude those participants whose impulsivity could be attributed to ADHD. This resulted in no participants being excluded at this stage and all invited participants agreed to take part in the experiment.

Design

There were three parts to the investigation. First, impulsivity was measured in both binge eaters and controls, using self-report inventories and a delay discounting procedure. Second, binge eaters were compared to controls on these measures of impulsivity. Third, the preference reversal model of relapse was tested. This involved offering choices of small soon rewards against large later rewards and varying the delay of the large reward. Three different larger-later delay values were selected for each participant based upon their performance in the delay-discounting task.

Measures

The Binge Eating Scale

The Binge Eating Scale (BES; Gormally et al, 1982) is a widely used 16-item self-report measure designed to assess binge eating severity in the non-purge binge eating population and to determine whether potential research participants meet the inclusion criteria of binge eating (Kolotkin, Revis, Kirkley, & Janick, 1987; Marcus, Wing & Hopkins, 1988; Marcus, Wing, & Lamparski, 1985; Wing, Marcus, Epstein, Blair, & Burton, 1989). The scale consists of 16 groups of four numbered statements, measuring (a) behavioural manifestations of binge eating (i.e., eating in secret, bolting down food); (b) emotional precipitants or consequences of binge eating (i.e. feeling ashamed of one's weight, feeling guilt or self-hatred following a binge); and (c) cognitive factors related to binge eating (i.e. food obsessions, preoccupation with dietary restraint). Participants chose the statement within each question, that best described the way they felt about their eating behaviour. Each statement has a scored weighting and the total scale score is the sum of the weights for the 16 items. It

shows high internal consistency (Cronbach's α 0.89), and good test-retest reliability (r = .87, p < .001) (Timmerman, 1999).

The *Behavioural Approach System and Behavioural Inhibition System Scale*

The Behavioural Approach System and Behavioural Inhibition System Scale (BIS/BAS; Carver & White, 1994) is a self-report questionnaire that assesses individual differences in personality dimensions that reflect the sensitivity of two motivational systems, the appetitive and aversive system. The BIS/BAS consists of 20 items that can be allocated to two primary scales: the Behavioural Approach System scale representing impulsivity (BIS; 7 items), and the Behavioural Inhibition System scale representing anxiety proneness (BAS: 13 items). The BAS can be divided into three subscales: fun-seeking (BAS-Fun; 4 items), reward responsiveness (BAS-Reward; 5 items), and drive (BAS-Drive; 4 items). The BIS/BAS scale is a reliable and valid measure yielding good internal consistency, with Cronbach's alpha varying between .65 and .83 (Jorm et al, 1999).

The Barrett Impulsivity Scale

The Barrett Impulsivity Scale, Version II (BIS-II; Patton, Stanford & Barrett, 1995) is a 30-item self-report questionnaire designed to assess general impulsivity. The scale measures (1) motoric impulsiveness (or proneness to reckless actions), (2) cognitive/attention impulsivity (or inability to maintain focussed attention) and (3) non-planning impulsiveness (or lack of concern for the future). The items are scored on a four-point scale (rarely/never [1], occasionally [2], often [3], almost always/always [4]) with total score denoted as "overall impulsivity". The BIS-II shows excellent reliability and validity (Patton et al, 1995) (Cronbachs α 0.79-.83

across four distinct groups: undergraduates, substance-abuse clients, general psychiatric clients, and prison inmates) and has been used widely in previous eating disorders research (Bruce, Koerner, Steiger, & Young, 2002; Paul, Schroeter, Dahme, & Nutzinger, 2002; Steiger, Young, Ying-Kin, Koerner, Israel, Lageix, et al, 2001).

The Adult ADHD Self-Report Scale

The Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist (ASRS; Adler, et al, 2003) is a self-report screening scale of adult attention-deficit/hyperactivity disorder (ADHD). It includes 6 questions about frequency of recent DSM-IV Criterion 'A' symptoms of adult ADHD. Each question is scored on a five-point scale (never, rarely, sometimes, often, and very often). If four or more marks appear within the 'sometimes', 'often', or 'very often' response boxes, the participant is identified as having symptoms highly consistent with ADHD in adults. The ASRS is identified as a reliable and valid scale for evaluating ADHD in adults and shows high internal consistency and high concurrent validity with the rater-administered ADHD-RS (Adler, McLaughlin, Rogers, Chang, Lapitsky & Lerner, 2006). This measure was used as a screening process, designed to exclude those participants whose impulsivity could be attributed to ADHD.

The Delay Discounting Task

An IBM compatible PC running an application programmed with MATLAB in Presentation 10.1 was used to present the experimental tasks to the participants on a 15" monitor. Throughout the tasks, responses were made via the computer keyboard. Five sets of laminated written instructions were provided at different stages of the experiment, each containing detailed instructions and, where applicable, diagrams of

the on-screen set-up - (i) preliminary instructions (ii) practice stage one instructions, (iii) practice stage two instructions, (iv) actual stage one instructions, (v) actual stage two instructions (see Appendix E).

The tasks consisted of a black screen and large white text displayed in Times New Roman font at all times. A condensed; text-only version of the written instructions was provided to participants on-screen before each stage. When delays were in progress, an animated ticking-clock graphic was presented, with a ticking sound-effect, and a numerical countdown timer displayed the remaining delay. Participants chose the smaller reward on the left side of the screen by pressing the 'S' key (this is on the left hand side of the keyboard) and the larger reward on the right hand side of the screen by pressing the 'L' key (this is on the right hand side of the keyboard).

In Stage One, participants were simply instructed to choose either a variable reward amount to receive immediately (3p, 6p, 9p, 12p or 15p) or a fixed amount of 15p to receive after a variable amount of seconds (10, 20, 40, 80 or 160 seconds). This stage was a computerised adjusting amounts procedure and therefore amounts of the immediate reward were adjusted following participant previous choices, in order to estimate the subjective value of the rewards at different delays. The immediate reward was started randomly on either 3p or 15p and respectively increased or decreased in following trials depending on whether the participant chose the delayed or immediate reward. When the point was reached at which the participant switched preference to the other reward, the value of the immediate reward was recorded by MATLAB as the subjective discounted value of the delayed reward (the *k* value). The task was repeated for the same delay duration but

with the immediate reward beginning on the other starting amount, to determine the second estimate of the subjective delayed reward value, which was used with the initial estimate to calculate the mean subjective value of the delayed reward. This entire process was repeated for the remaining delay durations (appearing randomly).

In Stage 2, participants had to choose between two rewards which were both delayed, and participants were additionally given the option of switching preference after the countdown had begun – with a red selection box indicating the current choice. In this task, participants were instructed to choose either 12p to receive after 20 seconds or 24p to receive after a variable number of seconds (calculated by MATLAB from the individual *k* values identified in stage one). These delay values corresponded to three conditions - either a larger/later preference (LP), a preference reversal (PRZ) or a smaller/sooner preference (SP) condition, each of which predicted a different choice outcome. The order in which these trials was presented was randomised with five trials being presented for each condition overall.

Procedure

Participants were selected based on their scores on the BES, which was submitted as an online intranet questionnaire, completion of which offered two course credits. Twenty high scorers (indicating binge-eating behaviour) and twenty low scorers (indicating no binge-eating behaviours) were approached by email and invited to participate in a laboratory study regarding 'making choices'. Participants were seated at a desk facing the computer screen on which the task would appear. They were then presented with an information sheet and consent form (see Appendix D).

A sheet of preliminary experiment instructions was given to the participant to read before commencing the task (see Appendix E). The participant was advised that the experimenter would stay in the room during the two practice trials so any questions concerning the experiment could be answered. Following this, participants were set up on the computer task and given the sheet of instructions to read for the practice trial of stage one. After reading these, participants were told to follow the on-screen instructions. Once the practice trial for stage one was completed, the participant was instructed on-screen to ask the experimenter for the practice trial stage two written instructions, which they were then given and any questions were once again answered. Upon completion of the two practice trials, the same procedure was conducted with the actual trials, with the exception that the experimenter left the room.

After actual trial one, the participant was advised on-screen of the amount of money they had earned for that trial and to call the experimenter for payment and to set up actual trial two. Upon completion of actual trial two, the participant was presented with the message 'Session Over – Please call the experimenter for payment'. The experimenter presented participants with the amount of money owing to them and a receipt for signature by the participant to confirm money had been received. Participants then completed the questionnaire pack. They were then presented with a written debrief (see Appendix F), and the opportunity to ask any remaining questions before they left the experiment.

As discussed, the experiment consisted of two stages. In the first stage, there were two independent variables, the first of which was the number of seconds delay until the larger reward could be received (which had values of 10, 20, 40, 80 and 160 seconds). The second independent variable was the amount of money the participant

could receive immediately, and had values of 3, 6, 9, 12 and 15 pence. The dependent variable in this stage was the participant's valuation of the larger delayed reward, which was fixed at 15 pence. This was a percentage value calculated by MATLAB, based on the equivalent value of the delayed reward determined through participant choosing in the adjusting-amounts procedure.

In stage two, the independent variable was the value of the delay for the larger reward, calculated based on individual participants' k values from stage one. There were two dependent variables in this stage, firstly the initial choice of the participant (SP or LP) and also the final choice of the participant (SP or LP), which indicated preference reversal if it had a different value to the initial choice.

Data Analysis

The computerised delay-discounting task was conducted to assess individual participants' levels of impulsivity, whereby indifference points identified from the delay-discounting task were input into Mazur's equation as v_d (the subjective value of the reward adjusted for the delay in its delivery), providing individual k values for each participant (higher k values indicative of higher levels of impulsivity). Mazur's hyperbolic formula (Equation 1) was then applied to these values to assess how well the participants' data fit the discounting model.

Following this, one-parameter non-linear regression analyses were conducted using k values to exclude those participants whose responses were not a good fit to the hyperbolic model. T-tests were then conducted to compare the impulsivity levels, derived from the delay-discounting task (k values) between the binge group and the control group.

Pearson correlations were conducted to examine any relationships between the

k values derived from the delay discounting task, and other behavioural measures of impulsivity – the Barrett Impulsivity Scale and the BIS/BAS scales.

Two repeated-measure ANOVAs were conducted to address whether or not the participants responded in the manner predicted by the preference reversal model (Bickel & Marsch, 2001). The number of choices of the larger later reward and the number of preference reversals was studied.

An alpha level of .05 was used for all statistical tests and SPSS for Windows (Version 11.0.0) was used for all statistical analyses.

RESULTS

Group Characteristics

Table 3 shows the mean scores for both groups for the standardised questionnaires measuring impulsivity. The binge-eating group had higher scores on all of the psychometric questionnaires indicating that the sample consisted of two distinctly different groups in respect of eating behaviour and impulsivity levels. The difference in impulsivity between groups was statistically significant on all questionnaires except for the three subscales of Behavioural Activation intended to represent impulsivity (BAS) – Drive, Fun-Seeking and Reward Responsiveness. Although the binge group showed higher scores on each BAS subscale, these did not reach significance. As well as a higher BAS, the binge-eating group was identified as having significantly higher BIS scores than the control group, which is conceptually independent of BAS. This finding is however consistent with other recent studies using Australian samples (Heubeck, Wilkinson & Cologon, 1998; Jorm, Christensen, Henderson, Jacomb, Korten & Rodgers, 1999). Perhaps it is possible that highly anxious participants may have inhibited their response to an initially novel task during

the practice trials, but were able to become less inhibited once the task had become more familiar in the actual trials (BIS related anxiety is extinguished by a rewarded trial).

Hyperbolic Discounting Rates

Hypothesis 1 aimed to address the question as to whether the hyperbolic formula would explain a significant proportion of participants' responses and show a goodness of fit to the hyperbolic discounting function (used as a basis throughout the research as a model of '*normal*', predicted behaviour).

Mean *k* values, derived from the delay discounting task, at each delay are plotted against the values predicted by Equation (1) and overall goodness of fit to the hyperbolic discounting curve for the total sample is depicted in Figure 4.

As shown in Figure 4, the hyperbolic function predicted a significant proportion of the variance in *k* values (R^2=.96, adjusted R^2=.95, standard error of the estimate = 6.36), $F_{1,4} = 102.85$ ($p = .001$). Although this suggests overall good fit, it was important to be aware that variability between individual participants was hidden. Thus, Figure 5 depicts the goodness of fit for a typical participant with a good fit to the hyperbolic curve ($R^2 = .88$) and Figure 6 depicts another participant with a less than good fit to the hyperbolic curve ($R^2 = .54$).

Table 3.

Means and standard deviations of standardised questionnaires

	Binge Group (n = 20)		Control Group (n = 20)		
Variable	*M*	*SD*	*M*	*SD*	*t*
Binge Eating Scale	23.90	3.08	2.25	2.22	25.52**
BIS/BAS Scale:					
BAS Drive	10.90	1.83	10.15	1.90	1.27
BAS Fun-Seeking	12.10	2.15	10.80	2.53	1.75
BAS Reward Responsivity	16.95	1.99	16.60	2.14	.54
Behavioural Inhibition	24.70	2.85	21.20	2.35	4.24**
Barrett Impulsivity Scale:					
Attentional Impulsivity	18.60	4.44	13.15	3.36	4.38**
Motoric Impulsivity	23.90	5.54	20.70	2.98	2.28*
Non-Planning Impulsivity	27.85	6.57	21.05	3.52	4.08**
Total Impulsivity	71.35	13.71	54.90	7.79	4.67**

* $p < .05$, ** $p < .01$

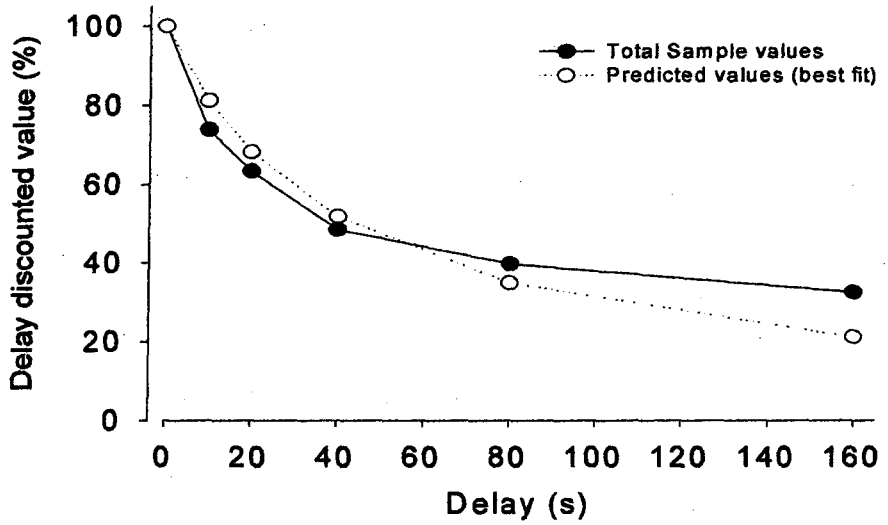


Figure 4. Goodness of fit for the total sample (n = 40) in relation to the hyperbolic curve.

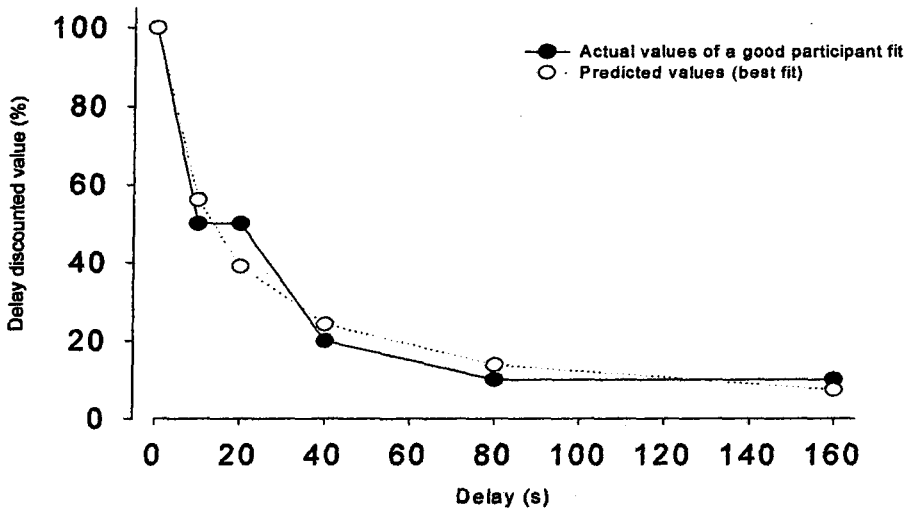


Figure 5. Goodness of fit for a participant with a good fit to the hyperbolic curve.

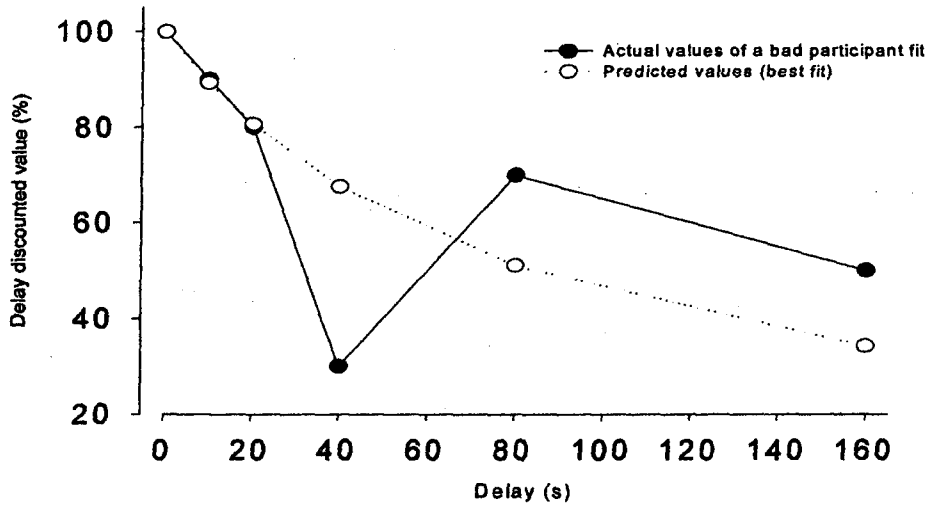


Figure 6. Goodness of fit for a participant with a poor fit to the hyperbolic curve.

Due to the variability between participants, which is not reflected using mean statistics, participants with an $R^2 < 0.7$ (i.e. a less than good fit to the hyperbolic curve) were excluded from all further analyses. This was achieved by conducting separate one-parameter non-linear regression analyses (R^2 value) for each participant, using their k values computed against the hyperbolic function to enable an assessment of goodness of fit. Previous empirical studies have indicated that an R^2 value of .7 and above is representative of a good fit to the behaviour predicted by Mazur's hyperbolic formula (Glautier, Rigney & Willner, 2001). This resulted in the number of participants being reduced by 8. All further analyses utilised the reduced sample size of 32 (Binge group = 14F, 2M; Control group = 14F, 2M).

Using the reduced sample size (n = 32), a graph depicting 'goodness of fit' is presented in Figure 7.

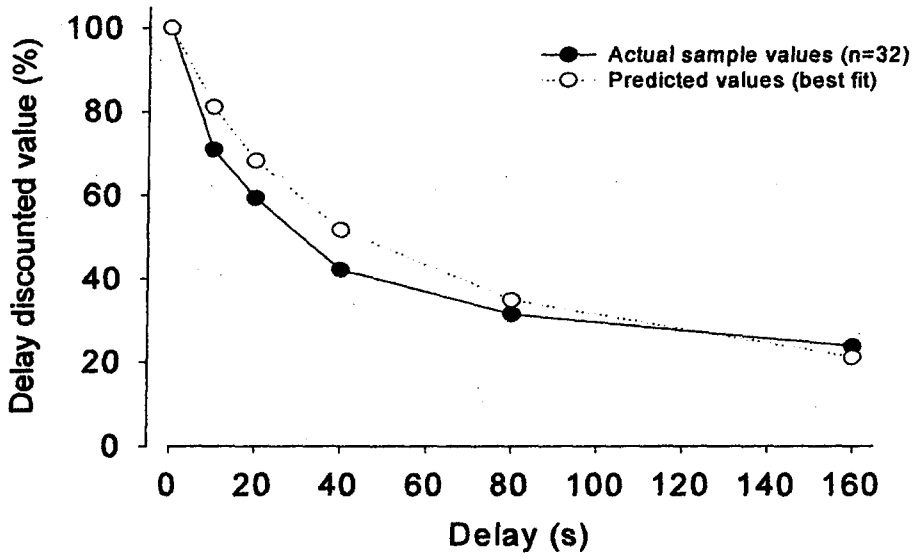


Figure 7. Goodness of fit for the reduced sample size of 32 participants (i.e. those with $R^2 > .7$) in relation to the hyperbolic curve.

The hyperbolic formula predicts a significant proportion of the variance in k values for the reduced sample (R^2=.97, adjusted R^2=.96, standard error of the estimate = 6.04), $F_{1,4} = 114.34$ ($p = .00$).

Group differences in levels of impulsivity (k values)

Figure 8 shows the relevant box-plots for the k values of the binge group and the control group. Using the reduced sample size of 32 (i.e. those participants with an $R^2 > .7$), no significant difference was found between the *k* values for each group, ($t_{(30)} = 1.96$, $p = .07$, binge groups mean $k = .11$, SD = .14; control group's mean $k = .04$, SD = .03). However, when the outliers (participant 12 and participant 30), as indicated in Figure 5, were excluded from the analysis, a significant difference was found between the *k* values for each group. Because the variances for the two groups were significantly unequal (F = .212, $p < .05$), a t-test for unequal variances was used

($t_{(28)} = 2.21, p = .042$).

It also became apparent that, when using participants with an $R^2 > .8$, (i.e. those participants with a better fit to the hyperbolic model; n = 25) there was a significant difference between the group's *k* values ($t_{(23)} = 2.23$, p = .045; binge groups mean *k* = .136, SD = .147; control groups mean *k* = .038, SD = .033). Using participants with a better fit to the hyperbolic formula, indicates more significant differences between the groups' levels of impulsivity.

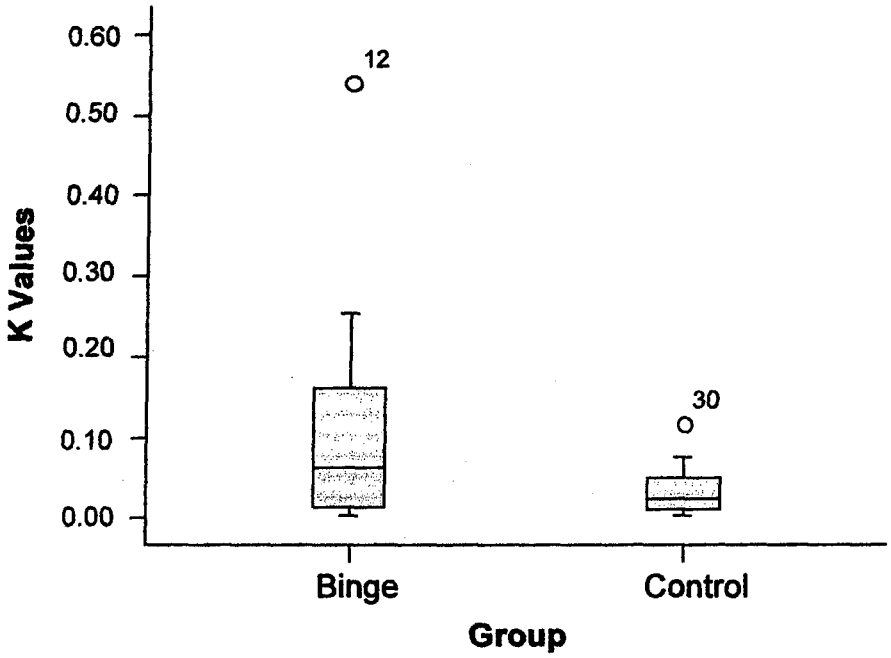


Figure 8. Box-plot of *k* values for binge group (n = 16) and control group (n = 16)

Correlations with k values

In an attempt to clarify research regarding relationships between behavioural and self-report measures of impulsivity, correlations between *k* values, the Barrett Impulsivity Scale, and the BIS/BAS scale, and associated *p* values are presented in Table 4. No significant correlations were evident between *k* values and the self-report measures of impulsivity used, supporting previous research identifying low correlations between self-report and behavioural scales (Gerbing et al, 1987).

However, high inter-correlations were identified within the self-report scales.

Test of the preference reversal model of relapse

Based on data from stage one of the experiment, discounting curves were generated for each participant (by fitting the participant's subjective values for each delayed reward to Mazur's equation) to support theoretical predictions for their pattern of choices in three conditions. For example, Figure 9 identifies the discounting curves generated for a participant, derived from their responses during stage 1 of the delay-discounting task. As can be seen, the theoretical curves allow us to identify the ranges within which the participant is like to make a larger/later (LL) choice, a preference reversal choice (PRZ), or a smaller/sooner (SS) choice. Across the three conditions, we predicted a decline in the probability of the larger later reward on initial choice. For example, it was predicted that most LL choices would be made within the range identified as being most likely for a LL choice; it was predicted that there was a moderate possibility that they might still make a LL choice within the predicted PRZ range, but it was predicted that there would be a very small probability that they would make a LL choice within the range identified as being the SS range).

In trials that predicted a larger/later preference, this choice was made 86% of the time. In trials that predicted a preference reversal, this choice was made 28% of the time and in trials that predicted a smaller/sooner preference, this choice was made 15% of the time. Figure 10 illustrates these data. A one-way correlated analysis of variance identified a significant difference between the three conditions ($F_{2,62} = 79.9$, $p = .000$). The LP mean was 4.34, the PRZ mean was 1.41, and the SP mean was .75. Related t-tests identified significant differences between each condition, LP-PRZ ($t_{31} = 8.83$, $p = .000$), LP-SP ($t_{31} = 11.69$, $p = .000$), and PRZ-SP ($t_{31} = 2.48$, $p = .02$).

These findings support the prediction of a decline in the probability of the LL reward on initial choice.

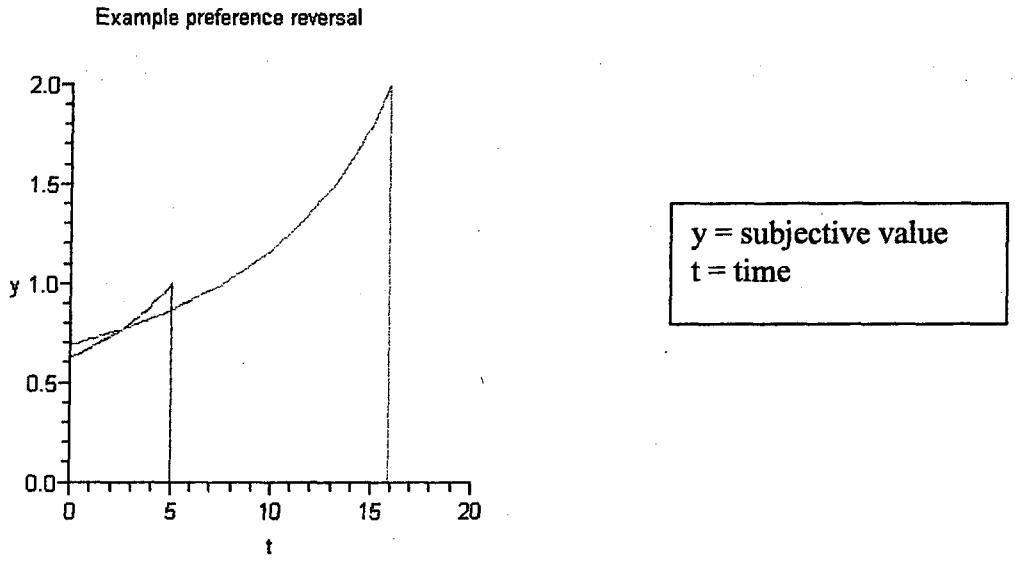


Figure 9. Graph to show theoretical predicted discounting curves for a participant, derived from their data from stage 1 of the delay-discounting task.

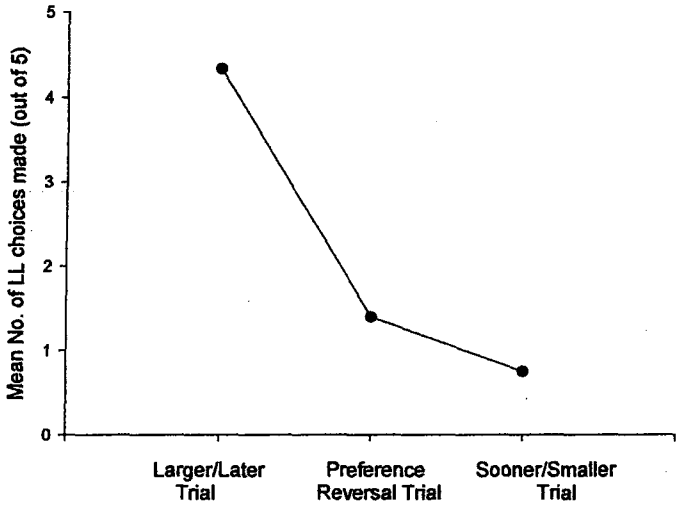


Figure 10. The number of times a larger/later choice was made in each condition.

Table 4.

Association (Pearson's r) of k values and self-report measures of impulsivity.

	1	2	3	4	5	6	7	8	9
(1) BAS Drive	--	.62**	.02	.26	.33	.45**	.20	.33	.28
(2) BAS F/S	.62**	--	.04	.21	.53**	.59**	.51**	.61**	.10
(3) BAS R/R	.02	.04	--	.18	.02	-.08	-.01	.03	.12
(4) BIS	.26	.21	.18	--	.39*	.15	.42*	.41*	.18
(5) Barrett Attentional Impulsivity	.34	.53**	.02	.39*	--	.60**	.78**	.91**	.06
(6) Barrett Motoric Impulsivity	.45**	.59**	-.08	.15	.60**	--	.57**	.67**	.08
(7) Barrett Non-planning Impulsivity	.20	.51**	-.02	.42*	.78**	.57**	--	.95**	.12
(8) Total Barrett Impulsivity	.33	.61**	.03	.41*	.91**	.67**	.95**	--	.14
(9) *k* values	.29	.10	.12	.18	.06	.08	.12	.14	--

* $p < .05$, ** $p < .01$

On the basis of the theoretical curves derived from the participants' data (discussed earlier), it was also predicted that the probability of switching from an LL choice to the SS choice, before time for the SS choice elapsed, would be greatest in

the range identified as being the preference reversal (PRZ) condition. For example, it was hypothesised that very few preference reversals would be made in either the LL condition or the SS condition, but the majority of preference reversals would be made within the range identified as being the PRZ condition.

Figure 11 shows the number of preference reversals made in each of the three conditions, given that a larger later choice was made initially. A one-way analysis of variance identified no significant difference between the number of preference reversals made in each condition ($F_{2,62} = .368$, $p = .694$), providing no support for our prediction. The mean number of preference reversals made in the LP condition was .06, in the PRZ condition .09, in the SP condition, .13. Although the ANOVA identified no significant differences in the amount of preference reversals made, it was apparent that an inadequate amount of switching was made to usefully analyse the results. The experiment would need to be replicated with an increased sample size.

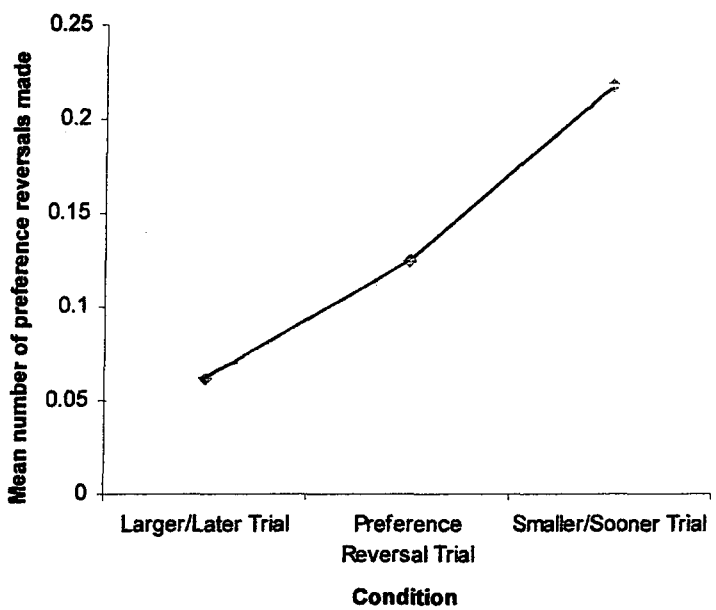


Figure 11. The mean number of preference reversals made in each condition.

DISCUSSION

The purpose of the present study was to elucidate the nature of the relationship between binge eating behaviour and impulsivity by using a delay-discounting task to measure levels of impulsivity within a group of binge eaters and a group of controls. This study also aimed to determine any convergent validity between self-report and behavioural measures of impulsivity and aimed to test the ability of the delay-discounting model to successfully predict preference reversals.

The results of the current study suggest that the relationship between impulsivity and binge eating behaviour is not as clear as might be expected intuitively. First, the results fitted the prediction that the hyperbolic discounting function would explain a significant proportion of the participants' responses in the delay-discounting task, such that variance accounted for by the hyperbolic function reached a sufficient level ($R^2 > .7$) for 32 of the participants (80%).

The study also identified a significant difference between groups on all self-report measures of impulsivity except the behavioural activation subscales of the BIS/BAS. The difference between the groups was also reflected in the delay-discounting task, which identified a significant difference in *k* values between groups, with the binge-eating group being significantly more impulsive (higher *k* values) than the control group (lower *k* values). This supports previous research identifying the ability of delay discounting to distinguish between impulsive groups and controls. For example, Madden et al (1997) found that participants with drug addictions showed steeper discounting of delayed rewards than controls; Petry & Casarella (1999) found steeper discounting of delayed rewards in substance abusers than non substance abusing controls and problem gambling substance abusers discounted

delayed rewards at higher rates than their non-problem gambling substance abusing counterparts. Petry (2001) identified more rapid discounting of delayed rewards in alcohol abusers compared to controls and Bickel et al (1999) identified higher discounting rates among cigarette smokers than non-smokers, using a delay-discounting task.

In two studies that examined differences between groups defined on the basis of personality traits, Ostaszewski (1996, 1997) compared extraverts with introverts and high with low impulsive groups (Eysenck, Eysenck, & Barrett, 1985). In both studies, the extravert and high impulsive groups showed steeper discounting of hypothetical delayed rewards than did the introvert and low impulsive groups.

The results of this study suggest that the construct of impulsivity is integral to understanding binge eating. It is the first study however, to demonstrate that temporal discounting is associated with non-clinical levels of binge eating. These findings are important since they suggest that the relationship between impulsivity and binge eating can be demonstrated in a non-clinical sample. As such the construct of impulsivity may be conceptualised as a continuous behavioural trait that may be associated with a range of binge eating behaviour. Since reliability of a discounting measure in college students has been reported previously (Simpson & Vuchinich, 2000), the present findings on the validity of the discounting approach provide further support for the psychometric quality of the procedure and can support the utility of using a discounting procedure with eating disordered individuals to predict who is at risk and who is most likely to benefit from interventions. Insofar as the discounting procedure can be used as a valid and reliable measure of impulsivity as it pertains to binge eating, it is important to replicate research findings that support the measure in this regard.

A lack of significant correlations between the *k* values derived from the delay-discounting task, and existing self-report measures of impulsivity, supports previous studies already recognised in the research literature positing that correlations between self-report and behavioural measures of impulsivity may be relatively low (Lane, Cherek, Rhodes, Pietras & Tcheremissine, 2003; Lejuez, Read, Kahler, Richards, Ramsey, Stuart et al, 2002; Mitchell, 1999; Monterosso, Ehrman, Napier, O'Brien & Childress, 2001; White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). For example, White et al (1994) found mixed results when comparing a battery of psychometric and behavioural tests of impulsivity. Several "positive but relatively weak" correlations within and between test types were observed. Other multi-method studies (Crean et al, 2000; Mitchell, 1999) have found either no relationship or negative correlations between measures of delay of reward and psychometric tests of impulsivity. Vuchinich and Simpson (1998) found only weak and sometimes inconsistent correlations between psychometric measures of impulsivity and k-parameter values when comparing participants, distinguished by their typical alcohol consumption, on the degree to which they discounted the value of delayed, hypothetical amounts of money.

A few studies have however found significant correlations between impulsivity scores on self-report measures and behavioural measures (Kirby, Petry, & Bickel, 1999; Madden et al, 1997; Petry, 2001) but interestingly, each of these studies examined discounting in participants with drug addictions. For example, three of the studies that examined discounting in participants with drug addictions and controls also looked at the correlation between behavioural discounting measures and psychometric test scores. Madden et al (1997) assessed participants using the Impulsivity subscale of the Eysenck Personality Questionnaire (EPQ; Eysenck &

Eysenck, 1978) and identified that, in participants with addictions, the correlation between impulsivity and the *k* parameter for heroin rewards was .40. These results parallel their finding that participants with drug addictions showed steeper discounting of delayed rewards. In a related study comparing people addicted to heroin with controls, Kirby et al (1999) obtained weak but significant positive correlations between the logarithm of *k* and measures of impulsivity from the Barratt Impulsiveness Scale (Barratt & Patton, 1983) and the Impulsiveness and Adventuresomeness subscales of the I-5 Questionnaire (Eysenck & Eysenck, 1978). Furthermore, Petry (2001) also observed a significant correlation between scores on the EPQ Impulsivity scale and discounting rates in substance abusers.

Less consistent relationships have been reported in studies involving smokers and drinkers. For example, Mitchell (1999) reported that smokers were significantly more impulsive than individuals who had never smoked on 19 of 28 personality measures that have been linked to impulsivity in the literature. However, the proportion of significant correlations between these measures and the logarithms of *k* (for hypothetical delayed rewards) was close to that which would be expected by chance. Moreover, Reynolds & Schiffbauer (2004) tested smokers and non-smokers and failed to find significant correlations between personality tests of impulsivity (Eysenck, Pearson & Easting, 1985) and sensation seeking (Zuckerman, 1971). In two experiments comparing groups that differed in their alcohol consumption, Vuchinich and Simpson (1998) found only weak and sometimes inconsistent correlations between psychometric measures and *k*-parameter values. In a study comparing alcoholics and non-alcoholics, however, Petry (2001) found a significant correlation between a psychometric measure of impulsivity (Eysenck et al, 1985) and *k*-parameter

values when hypothetical delayed monetary rewards were studied but not when hypothetical delayed alcohol rewards were studied.

It is unclear why weaker and inconsistent relationships between behavioural and psychometric measures were observed with smokers, alcoholics, and heavy drinkers compared with those obtained with opioid-dependent groups. The relevant studies differed, however, in several respects in addition to the type of substance abused. For example, the sample sizes in the studies involving individuals addicted to heroin tended to be larger than those involving smokers and drinkers. In addition, different psychometric measures were used in the various studies (although there was some overlap), making comparisons difficult.

Collectively, both this study and the aforementioned studies suggest that measures tend to correlate more strongly within than across test types. Based on factor-analytic outcomes from a battery of impulsivity tests, White et al (1994) proposed two dimensions of impulsivity - "cognitive" and "behavioural". These designations were made based on interpretations of tests and subscales with positive loadings following factor analyses. Although this study makes no attempt to interpret results along these dimensions, the high inter-correlations on the psychometric tests found here and in previous reports suggest that the psychometric tests may be measuring the same psychological dimension. Perhaps some tests predict risk for relapse via measurement of intractable behaviour patterns, while others measure dysfunctional decision-making in acute choice situations. This possibility heightens the need for careful interpretation of impulsivity data in both research and clinical settings. Further studies into the variations and relationships among the available measures of impulsivity and binge eating may also help inform treatment decisions that can be tailored to the needs of individual clients. Research also is needed to

evaluate the utility of behavioural discounting measures for predicting individual risk of engaging in problem behaviours. Knowing the degree to which discounting measures converge on the same construct as psychometric measures of impulsivity, and whether discounting measures predict future behaviour, may shed light on what discounting procedures actually measure.

The present data suggest that several commonly used psychometric and behavioural measures of impulsivity may assess different behaviour patterns, characteristics, or dimensions that are all commonly labelled as impulsive. Prior studies have concluded that impulsivity may be a multidimensional construct and the present data support this hypothesis.

The ability of the hyperbolic discounting model to account for reversals of preference over time has received strong support from a variety of disciplines. For example, Kirby and Herrnstein (1995) offered 36 participants choices between delayed rewards whilst manipulating the delays to those rewards. They identified that preferences typically reversed with changes in delay, as predicted by hyperbolic discounting models of impulsiveness. Furthermore, Saunders and Fogarty (2001) tested the preference reversal model by giving 26 participants choices relating to their career preference, i.e. a future senior managerial position, or a lesser management role available immediately. Twenty-three out of 26 participants reversed their career choice from the future senior role to the lesser management role.

Within this study however, results as to whether the delay-discounting model can successfully predict preference reversals, were equivocal. The prediction of a decline in the probability of an LL reward on initial choice across the three conditions was substantiated. However, the prediction that preference reversals would occur most frequently within the PRZ condition was not supported as an inadequate amount

of preference reversals was made, making the data unsuitable for analysis. One potential reason for a lack of preference reversals being made might be that the experimental task made participants fully aware that they were being assessed and so made them more defensive to threats against their self-image. Switching preference impulsively from a larger later reward to a smaller, sooner reward could be seen by participants as a sign of weakness and therefore may have been avoided within the experimental context.

A further reason for the lack of preference reversals might be that the preference reversal parameters were too small. The delays that differentiated conditions may have been too small and precise to predict reliable differences in responding. It may be that behaviour cannot be predicted with precision over such a short time-scale and it may therefore be advisable for future research to employ larger delay intervals between prediction conditions and make predictions about behaviour with regards to minutes, hours and days for example, as opposed to seconds.

It might also be suggested that the rewards in this study were too insubstantial to motivate preference reversal in the PRZ conditions. There is now a substantial body of evidence that smaller delayed rewards are discounted more steeply than larger delayed rewards. The effect of amount on rate of temporal discounting (often referred to as the *magnitude effect*) has been shown in numerous studies of human decision making involving both real and hypothetical monetary rewards (e.g. Benzion, Rapoport & Yagil, 1989; Green et al, 1994; Green, Fry & Myerson, 1994; Johnson & Bickel, 2001; Kirby, 1997; Kirby & Marakovic, 1995; Myerson & Green, 1995; Raineri & Rachlin, 1993; Thaler, 1991), as well as other commodities as diverse as medical treatments, holiday trips, and career choices (Baker et al, 2003; Chapman,

1996; Chapman & Elstein, 1995; Raineri & Rachlin, 1993). Future research might replicate the experiment with larger amounts or hypothetical amounts of money.

This study incorporated real rewards into the discounting task, based on a study by Kirby (1997) who noted that studies using real rewards reported steeper discounting rates than those studies using hypothetical rewards. He suggested that there might be real differences in discounting the two types of reward, although he also pointed out that the observed difference in discounting rates might reflect the fact that studies using real rewards tended to use smaller amounts than the studies using hypothetical rewards. Indeed, Johnson and Bickel (2001) and Madden et al (2003), who tested the same participants with both real and hypothetical monetary rewards of the same amount, found no systematic differences in the rate of discounting. This conclusion is similar to that reached by Camerer and Hogarth (1999) after an extensive review of the literature on financial incentives in experimental economics more generally. They concluded that methods involving hypothetical choices and those involving real consequences typically yield qualitatively similar results.

Thus, at present, previous research supports the idea that the discounting of real and hypothetical rewards is at least qualitatively similar (see also Frederick et al, 2002) and replication of the study using larger, hypothetical rewards may provide more conclusive data with which to study the phenomenon of preference reversals.

Limitations

Some limitations to the present study need to be acknowledged. With the exception of the psychometric instruments, the data are characterized largely by non-significant correlations and this may in part be related to the small sample size, which was constrained by reward and budgetary considerations. Furthermore, mostly

females were studied. This sample size and the gender limitation necessarily limit the scope of the conclusions. Direct gender comparisons and replication of these data with a larger N will be needed to confirm the present outcomes and thus, in this regard, these data may be viewed as a preliminary finding.

Future studies might consider inclusion of a negative affect measure when investigating impulsivity and binge eating, bearing in mind the consideration that binge eating is often believed to be an impulsive reaction to negative affect. Evident relationships have been discussed in the literature. Indeed Bekker, van de Meerendonk and Mollerus (2004) conducted a study to investigate the influence of negative mood induction and impulsivity on self-perceptions with respect to emotional eating. They identified significant interactions between affect, emotional eating and impulsivity in college students who were high versus low in impulsivity and were assigned randomly to either a negative (failure on a quiz) or a neutral mood condition. Results showed that highly impulsive participants were more strongly influenced by negative affect in their self-perceived emotional eating, compared to participants low in impulsivity. Future delay discounting studies investigating the interaction effect between impulsivity, negative affect and binge eating might further elucidate the relationship between these variables.

A further consideration with regards to replication of this study might include the use of a sample with a larger age range. Although the peak period of onset for binge eating is age 18 (range of 14-24 years), binge eating can affect people of any age. It has been identified that, with age, there is a developmental decrease in how steeply delayed rewards are discounted (Green, Myerson & Ostaszewski, 1999), suggesting developmental changes in the way that time and amount are scaled. Green et al (1999) assessed three groups of participants – 12 children (mean age of 12), 12 young

adults (mean age of 20), and 20 older adults (mean age of 69) and identified that, as individuals get older, they appear to discount the value of delayed rewards less steeply and, in addition, the shape of the discounting function changes systematically.

In a previous study comparing the discounting behaviour of children and young and older adults, participants were given a choice between immediate and delayed hypothetical monetary rewards (Green, Fry & Myerson, 1994). As the time until receipt of the delayed reward increased, the present value of the reward decreased in all three age groups, but the rate of decrease was greatest for the child group (mean age=12 years), intermediate for the young adults (mean age=20 years), and least for the older adults (mean age=68 years), identifying age-related increases in self-control. Future studies, utilising a sample with a more diverse age range might further elucidate the relationship between binge eating and impulsivity across the lifespan.

Future Considerations

Dialectical Behavioural Therapy (DBT)and Binge Eating

NICE guidelines for eating disorders (2004) recommend a 16-20-session treatment of Cognitive Behavioural Therapy (CBT) for binge eating disorder. To date CBT is the most extensively studied treatment for individuals with BED and is based on a cognitive-behavioural model of binge eating which postulates that binge eating develops in response to restrictive food intake and occurs in the context of ongoing dietary restraint and the experience of negative emotions. CBT has consistently been shown to be more effective than no treatment in decreasing the frequency of binge eating and in improving the psychopathology associated with binge eating. However, binge eating is generally associated with poor treatment prognosis with remission

rates for CBT generally being high (e.g. > 50%) (DeZwaan & Friederich, 2006) and sparse data exists to demonstrate the benefits of CBT over the long term.

The reason that binge eaters show such a poor response to interventions that focus only on relaxing dietary restraint might be because such treatments target a dimension that is only peripheral to the maintenance of binge eating behaviours. Interventions that target impulsivity and aim to improve self-control skills might be more pertinent. Recently, Dialectical Behavioural Therapy (DBT; Linehan, 1993), originally designed for the treatment of individuals with borderline personality disorder, has also shown promise in the treatment of binge eating. DBT has previously shown good therapeutic outcomes for borderline personality disordered clients, whose impulsive behaviours are similar to, co-morbid with and associated with binge eating clients. It appears that several features of DBT make it particularly useful for impulsive people, i.e. the teaching of skills applicable to impulse control, emotional regulation and distress tolerance. The first research investigation of DBT's effectiveness with binge eating disorders was very promising, though small. Of 18 participants, with an average duration of 29 year's of bingeing, 16 (89%) had stopped binge eating by the end of treatment. Of those in a control group who did not receive DBT, only 12% stopped bingeing. At follow up, six months later, 56% of the participants were still abstinent from binge eating (Wiser & Telch, 1999). Research is continuing but existing data show that DBT, with its focus on impulse regulation, may be a promising intervention for those suffering with binge eating disorders

Bundling

In order to reduce impulsive behaviour and enhance self-control, it has been identified that bundling individual choices into classes of choices that are made at

once, can make human decision making far less myopic. Bundling (Ainslee & Monterosso, 2003) is the process by which highly impulsive people may be able to temper their impulsive behaviour. If a current choice is "bundled" with series of like future choices, and made at once, preference can be made less impulsive. Consider a binge eater interested in refraining from bingeing, who, for whatever reason, believed that their choice of whether to binge that morning would be a binding determinant of all future bingeing choices; if they binged, they would continue bingeing at the current rate for the rest of their life, but if they did not, they would never binge again. Presumably the aspiring non-binger in this situation would be more likely to refrain from bingeing. Such a decrease in impulsiveness when future choices are grouped with current choices is predicted by hyperbolic discounting. The binge right now may be more valued that the expected beneficial consequences of abstaining from that binge but each delayed binge may be less valued than the expected consequences of abstaining. If someone could bundle a series of these future binges with the current binge, they could tip the balance away from that impulsive choice. Specifically, when a person's expectations about their own future behaviour are conditional upon their current behaviour, the value of these expectations is added to the contingencies for the current behaviour, resulting in reduced impulsivity.

Experiments with human subjects confirm a greater tolerance for delay with bundled rewards. Kirby and Guastello (2001) gave college students monetary choices between smaller and earlier rewards and larger but delayed alternatives. In one condition, the choice was made 5 times, each time separated by one week. In another condition, the choice was made between the two alternatives up front for all 5 weeks at once. As predicted, from the summation of hyperbolically discounted rewards,

preference for the larger/later alternative was increased in the condition in which a series of choices was bundled together.

Furthermore, Read, Loewenstein and Kalyanaraman (1999) found that when people picked three rental movies sequentially rather than simultaneously, they were less likely to include "high-brow" films (as opposed to more tempting "low-brow" films). Simultaneous choice for each of three viewings allowed pre-commitment, and the proportion of "high-brow" films increased. Khan (2004) found that opting for 'vice' (e.g. a biscuit) over virtue (e.g. low fat yoghurt) increased when subjects expected to have the same options later. Ariely and Wertenbroch (2002) found that people who had the option of pre-committing to a series of deadlines did better at a task, and met the deadlines better, than subjects who could submit at any time up to the final deadline. Subjects who had evenly spaced deadlines imposed upon them beat them, in both categories. A study with rats, offered SS and LL rewards of sugar water, found that the rats opted for the LLs more often when offered a batch of three than when offered the single options separately (Ainslie & Monterosso, 2003). These results support the hypothesis that bundling pairs of SS-LL choices results in a greater preference for LLs than when choices are made singly.

Read et al (1999) suggest that because simultaneous choice enables decision makers to take the "big picture", they can better choose options that optimise the overall experience even if some of those options are not the best when taken by themselves.

The concept of bundling initially appears effective in preventing temporary preferences for SSs and reducing impulsive choice. It would be an interesting concept to relate this idea of bundling more specifically to binge choices and clinical

populations to investigate whether the consequences involve reduced impulsivity. This is certainly a promising area for future research.

Tolerance for Delay

Training and history have also been found to influence choice behaviour. Several researchers have attempted to discover whether or not subjects can be taught to increase their relative rates of selecting more ultimately advantageous consequences (i.e. to increase their self-control). For example, Schweitzer & Sulzer-Azaroff (1988) conducted research to teach tolerance for delay to impulsive children. Six pre-schoolers, including one comparison participant, identified by their teachers as impulsive, were pre-assessed and were found to consistently select smaller immediate re-inforcers over larger, more delayed ones. The teaching procedure consisted of gradually increasing the delay interval preceding reinforcement over many sessions. The follow-up assessments showed that five of these children increased the proportion of their choices of the delayed reinforcers. The study also identified that distractors (i.e. singing) served to facilitate children's choices of larger, more delayed reinforcers. The study concludes that it is feasible to teach young children to make choices more advantageous to them in the long run.

Conclusion

Consistent with Mazur's hyperbolic discounting model and in line with previous research, this study was able to identify that the behaviour of this sample was well described by Mazur's hyperbolic formula and added to previous research by identifying that binge eaters display higher levels of impulsivity than controls using the delay discounting procedure. The study was unable to identify any significant

correlations between the delay discounting procedure and existing self-report measures of impulsivity, highlighting the need to conceptualise impulsivity as a multi-dimensional construct and questioning whether eating pathology aligns itself only with certain components of impulsivity. Finally the study tested the utility of using the delay-discounting model to predict preference reversals and further elucidate the nature of the relapse phenomenon. The study was unable to support this utility due to the data being unsuitable for analysis.

Results suggest that when considering the propensity to binge eat, impulsivity is an important factor and may be equally or more closely associated with core features of binge eating psychopathology such as negative affect and cognitive restraint. At present, the advised therapy for binge eating behaviour is CBT. The current study raises the question as to whether it would be more effective to include measures that enhance a binge-eating individual's ability to tolerate delay, using techniques such as impulse regulation skills or bundling, as opposed to concentrating solely on the concepts of dietary restraint and negative affect.

Future research is required to consolidate and support the utility of using delay- discounting procedures with binge eating clients and to further understand the inconsistent relationships between self-report and behavioural measures of impulsivity. Further research is also needed to support the predictive validity of behavioural discounting. With respect to binge eating behaviours, for example, it would be important to know whether discounting rates can be used to predict the likelihood of future binge eating behaviour. So, too, it would be useful to be able to predict which individuals would be more successful at giving up this behaviour. If discounting measures can be shown to be correlated with future behaviour in prospective studies, then such measures could be used to predict who is at risk and

who is most likely to benefit from interventions and perhaps even match individuals with prevention or treatment approaches that would be most effective for them.

REFERENCES

Adler, L., Kessler, R., & Spencer, T. (2003). *Adult Self Report Scale, ASRS-VI.1. Screener.* World Health Organisation, New York.

Adler, D. A., McLaughlin, T. J., Rogers, W. H., Chang, H., Lapitsky, L., & Lerner, D. (2006). Job performance deficits due to depression. *American Journal of Psychiatry, 163*, 1569-1576.

Ainslee, G. (1992). *Picoeconomics: The Strategic Interaction of Successive Motivational States with the Person.* Cambridge, Cambridge University Press.

Ainslee, G., & Monterosso, J. R. (2003). Building blocks of self-control. Increased tolerance for delay with bundled rewards. *Journal of the Experimental Analysis of Behaviour, 79,* 37-48.

Alessi, S. M., & Petry, N. M. (2003). Pathological gambling severity is associated with impulsivity in a delay discounting procedure. *Behavioural Processes, 64,* 345-354.

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV.* 4th ed). Washington, DC: APA Press.

Ariely, D., & Wertenbroch, K. (2002). Procrastination, deadlines, and performance: Self control by precommitment. *Psychological Science, 13,* 219-224.

Baker, F., Johnson, M. W., & Bickel, W. K. (2003). Delay discounting in current and never-before smokers: Similarities and differences across commodity, sign and magnitude. *Journal of Abnormal Psychology, 112,* 382-392.

Barratt, E. S., & Patton, J. H. (1983). Impulsivity: Cognitive, behavioural, and psychophysiological correlates. In: Zuckerman M, ed. *Biological Bases of Sensation Seeking, Impulsivity and Anxiety.* Hillsdale, NJ: Lawrence Erlbaum.

Bekker, M. H., van de Meerendonk, C., & Mollerus, J. (2004). Effects of negative mood induction and impulsivity on self-perceived emotional eating. *International Journal of Eating Disorders, 36,* 461-469.

Benzion, U., Rapoport, A., & Yagil, J. (1989). Discount rates inferred from decisions: An experimental study. *Management Science, 35,* 270-284.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioural economic understanding of drug dependence: delay discounting processes. *Addiction, 96,* 73-86.

Bickel, W. K., Odum, A. L., & Madden, G. J. (1999). Impulsivity and cigarette smoking: delay discounting in current, never, and ex-smokers. *Psychopharmacology, 146,* 447-454.

Bruce, K., Koerner, N., Steiger, H., & Young, S. (2002). Laxative misuse and behavioural disinhibition in bulimia nervosa. *International Journal of Eating Disorders, 33,* 92-97.

Camerer, C. F., & Hogarth, R. M. (1999). The effects of financial incentives in experiments: A review and capital-labour production framework. *Journal of Risk and Uncertainty, 19,* 7-42.

Carver, C. S., & White, T. L. (1994). Behavioural inhibition, behavioural activaton, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology, 67,* 319-333.

Chapman, G. B. (1996). Expectations and preferences for sequences of health and money. *Organisational Behaviour and Human Decision Processes, 67,* 59-75.

Chapman, G. B., & Elstein, A. S. (1995). Valuing the future: Temporal discounting of health and money. *Medical Decision Making, 15,* 373-386.

Claes, L., Vandereycken, W., & Vertommen, H. (2002). Personality traits in eating disordered patients with and without self-injurious behaviours. *Journal of Personality Disorders, 18*, 399-404.

Crean, J. P., DeWit, H., & Richards, J. B. (2000). Reward discounting as a measure of impulsive behaviour in a psychiatric outpatient population. *Experimental and Clinical Psychopharmacology, 8,* 155-162.

DeZwaan, M., & Frederich, H. C. (2006). Binge Eating Disorder. *Ther Umsch, 63*, 529-533.

DeZwaan, M., Mitchell, J. E., Seim, H. C., Specker, S. M., Pyle, R. L., Raymond, N. C, et al. (1994). Eating related and general psychopathology in obese females with binge eating disorder. *International Journal of Eating Disorders, 15,* 43-52.

Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology, 146,* 348-361.

Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. *Psychological Reports, 43,* 1247-1255.

Eysenck, S. B., Eysenck, H. J., & Barrett, P. (1985). A revised version of the Psychoticism scale. *Personality and Individual Differences, 6*, 21-29.

Eysenck, S. B., Pearson, P. R., & Easting, G. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. *Personality and Individual Differences, 6,* 613–619.

Fassino, S., Abbate Daga, G., Amianto, F., Leombruni, P., Boggio, S., & Rovera, G. G. (2002). Temperament and character profile of eating disorders: A controlled study with the Temperament and Character Inventory. *International Journal of Eating Disorders, 4,* 412-425.

Frederick, S., Loewenstein, G., O'Donoghue, T. (2002). Time discounting: A critical review. Journal of Economic Literature (in press).

Gerbing, D. W., Ahadi, S. A., & Patton, J. H. (1987). Toward a conceptualisation of impulsivity: components across the behavioural and self-report domains. *Multivariate Behavioural Research, 22,* 375-379.

Glautier, S., Rigney, U., & Willner, P. (2001). Motivation for alcohol assessed by multiple variable interval schedule behaviour: effects of reward size and alcohol cues. *Behavioural Pharmacology, 12,* 81-89.

Gluck, M. E., Geleibter, A., Hung, J., & Yahav, E. (2004). Cortisol, hunger and desire to binge eat following a cold stress test in obese women with binge eating disorder. *Psychosomatic Medicine, 66,* 876-881.

Gormally, J., Black, S., Daston, S., & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviours, 7,* 47-55.

Gray, J. A. (1970). The psychophysicological basis of introversion-extraversion. *Behavioural Research and Therapy, 8,* 249-266.

Green, M. W., Elliman, N. A., & Rogers, P. J. (1996). Hunger, caloric preloading and the selective processing of food and body shape words. *The British Journal of Clinical Psychology, 35,* 143-151.

Green, L., Fristoe, N., & Myerson, J. (1994). Temporal discounting and preference reversals in choice between delayed outcomes. *Psychonomic Bulletin & Review, 1,* 383-389.

Green, L., Fry, A. F., & Myerson, J. (1994). Discounting of delayed rewards: a lifetime comparison. *Psychological Science, 5,* 33-36.

Green, L., & Myerson, J. (1993). Alternative frameworks for the analysis of self-control. *Behavioural Philosophy, 21,* 37-47.

Green, L., & Myerson, J. (2004). A discounting framework for choice with delayed and probabilistic rewards. *Psychological Bulletin, 130,* 769-792.

Green, L., Myerson, J., & Ostaszewski, P. (1999). Discounting of delayed rewards across the lifespan: Age differences in individual discounting functions. *Behavioural Processes, 46,* 89-96.

Heubeck, B. G., Wilkinson, R. B., & Cologon, J. (1998). A second look at Carver & White's (1994) BIS/BAS Scales. *Personality and Individual Differences, 25,* 785-800.

Johnson, M. W., & Bickel, W. K. (2001). Within subject comparison of real and hypothetical money rewards in delay discounting. *Journal of Experimental Analysis of Behaviour, 77,* 129-146.

Jorm, A. F., Christensen, H., Henderson, A. S., Jacomb, P. A., Korten, A. E., & Rodgers, B. (1999). Using the BIS/BAS Scales to measure behavioural inhibition and behavioural activation: Factor structure, validity and norms in a large community sample. *Personality and Individual Differences, 26,* 49-58.

Kane, T., Loxton, N. J., Staiger, P., & Dawe, S. (2004). Does the tendency to act impulsively underlie binge eating and alcohol use problems? An empirical investigation. *Personality and Individual Differences, 36,* 83-94.

Keel, P. K., Mitchell, J. E., Miller, K. B., Davis, T. L., & Crow, S. J. (2000). Predictive validity of bulimia nervosa as a diagnostic category. *American Journal of Psychiatry, 157,* 136-138.

Khan, U. (2004). *Effect of future choices on current preferences.* Unpublished master's thesis, Yale School of Management, Yale University.

Kirby, K. N. (1997). Bidding on the future: evidence against normative discounting of delayed rewards. *Journal of Experimental Psychology: General Processes, 126,* 54-70.

Kirby, K. N., & Guastello, B. (2001). Making choices in anticipation of similar future choices can increase self-control. *Journal of Experimental Psychological Applications, 7,* 154-164.

Kirby, K. N., & Hernstein, R. J. (1995). Preference reversals due to myopic discounting of delayed reward. *Psychological Science, 6,* 83-89.

Kirby, K. N., & Markovic, N. N. (1995). Modelling myopic decisions: Evidence for hyperbolic delay discounting within subjects and amounts. *Organisation of Behaviour and Human Decision Processes, 64,* 22-30.

Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology-General, 128,* 78–87.

Kolotkin, R., Revis, E., Kirkley, B., & Janick, L. (1987). Binge eating in obesity: Associated MMPI characteristics. *Journal of Consulting and Clinical Psychology, 55,* 872-876.

Lane, S. D., Cherek, D. R., Rhodes, H. M., Pietras, C. J., & Tcheremissine, O. V. (2003). Relationships among laboratory and psychometric measures of impulsivity: Implications in substance abuse and dependence. *Addictive Disorders and their Treatment, 2,* 33-40.

Lecrubier, Y., Braconnier, A., Said, S., & Payan, C. (1995). The Impulsivity Rating Scale (IRS): preliminary results. *European Psychiatry, 10,* 331-338.

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., & Stuart, G. L. et al. (2002). Evaluation of a behavioural measure of risk-taking: The

Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied, 8,* 75-84.

Linehan, M. (1993). *Cognitive-behavioural treatment for borderline personality disorder: The dialectics of effective treatment.* The Guilford Press, New York.

Logue, A. W. (1988). Research on self-control: an integrated framework. *Behavioural Brain Science, 11,* 665–709.

Madden, G. J., Begotka, A. M., Raiff, B. R., & Kastern, L. L. (2003). Delay discounting of real and hypothetical rewards. *Experimental and Clinical Psychopharmacology, 11,* 139-145.

Madden, G. J., Petry, N. M., Badger, G. J., & Bickel, W. K. (1997). Impulsive and self-control choices in opioid-dependent patients and non-drug-using control participants: drug and monetary rewards. *Experimental Clinical Psychopharmacology, 5,* 256-262.

Marcus, M., Wing, R., & Hopkins, J. (1988). Obese binge eaters: affect, cognitions, and response to behavioural weight control. *Journal of Consulting and Clinical Psychology, 56,* 433-439.

Marcus, M. D., Wing, R. R., & Lamparski, D. M. (1985). Binge eating and dietary restraint in obese patients. *Addictive Behaviours, 10,* 163-168.

Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In: Commons, M. L., Mazur, J. E., Nevin, J. A., & Rachlin, H. (Eds.) *Quantitative analysis of behaviour (vol. 5).* The effect of delay and of intervening events on reinforcement value, pp. 55-73. Hillsdale, NJ, Erlbaum.

Millar, A., & Navarick, D. J. (1984). Self-control and choice in humans: Effects of video game playing as a positive reinforcer. *Learning and Motivation, 15,* 03-218.

Mitchell, S. H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology, 146,* 455-464.

Monterosso, J., Ehrman, R., Napier, K. L., O'Brien, C. P., & Childress, A. R. (2001). Three decision-making tasks in cocaine-dependent patients: Do they measure the same construct? *Addiction, 96,* 1825-1837.

Myerson, J., & Green, L. (1995). Discounting of delayed rewards: Models of individual choice. *Journal of the Experimental Analysis of Behaviour, 64,* 263-276.

Navarick, D. J. (1982). Negative reinforcement and choice in humans. *Learning and Motivation, 13,* 361-377.

Navarick, D. J. (2004). Discounting of delayed reinforcers. Measurement by questionnaires versus operant choice procedures. *The Psychological Record, 54,* 85-94.

Newman, J. P., Patterson, E. W., Howland, E. W., & Nichols, S. L. (1990). Passive avoidance in psychopaths: The effects of reward. *Personality and Individual Differences, 11,* 1101-1114.

Ostaszewski, P. (1996). The relation between temperament and rate of temporal discounting. *European Journal of Personality, 10,* 161-172.

Ostaszewski, P. (1997). Temperament and the discounting of delayed and probabilistic rewards: Conjoining European and American traditions. *European Psychologist, 2,* 35-43.

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology, 51,* 768-774.

Paul, T., Schroeter, K., Dahme, B., & Nutzinger, D. O. (2002). Self-injurious behaviour in women with eating disorders. *American Journal of Psychiatry, 159*, 408-411.

Petry, N. M. (2001). Substance abuse, pathological gambling, and impulsivity. *Drug and Alcohol Dependence, 63*, 29-38.

Petry, N. M., & Casarella, T. (1999). Excessive discounting of delayed rewards in substance abusers with gambling problem. *Drug and Alcohol Dependence, 56,* 25-32.

Powell, J. H., Al-Adawi, S., Morgan, J., & Greenwood, R. J. (1996). Motivational deficits after brain injury: effects of bromocriptine in 11 patients. *Journal of Neurology, Neurosurgery and Psychiatry, 60,* 416–421.

Rachlin, H., Raineri, A., & Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behaviour, 55,* 233-244.

Raineri, A., & Rachlin, H. (1993). The effect of temporal constraints on the value of money and other commodities. *Journal of Behavioural Decision Making, 6,* 77-94.

Read, D., Loewenstein, G., & Kalyanaraman, S. (1999). Mixing virtue and vice: the combined effects of hyperbolic discounting and diversification. *Journal of Behavioural Decision Making, 12,* 257-273.

Reynolds, B., & Schiffbauer, R. (2004). Measuring state changes in human delay discounting: An experiential discounting task. *Behavioural Processes, 67*, 43-56.

Saunders, B., & Fogarty, G. (2001). Time discounting in relation to career preferences. *Journal of Vocational Behaviour, 58*, 118-126.

Schweitzer, J. B., & Sulzer-Azaroff, B. (1988). Self-control: Teaching tolerance for delay in impulsive children. *Journal of Experimental Analysis of Behaviour, 50*, 173-185.

Simpson, C. A., & Vuchinich, R. E. (2000). Reliability of a measure of temporal discounting. *The Psychological Record, 50*, 3-16.

Steiger, H., Young, S., Ying Kin, N., Koerner, N., Israel, M., Lageix, P. et al (2001). Implications of impulsive and affective symptoms for serotonin function in bulimia nervosa. *Psychological Medicine, 31*, 85-95.

Thaler, R. (1991). *Quasi Rational Economics.* New York: Russell Sage Foundation.

Timmerman, G. M. (1999). Binge Eating Scale: Further assessment of validity and reliability. *Journal of Applied Biobehavioural Research, 4(1),* 1-12.

Vervaet, M., Van Heeringen, C., & Audengert, K. (2004). Personality-related characteristics in restricting versus bingeing and purging eating disordered patients. *Comprehensive Psychiatry, 45,* 37-43.

Vuchinich, R. E., & Simpson, C. A. (1998). Hyperbolic temporal discounting in social drinkers and problem drinkers. *Experimental Clinical Psychopharmacology, 6,* 292-305.

Watson, D., & Clark, L. A. (1993). Behavioural disinhibition versus constraint: A dispositional perspective. In D. M. Wegner & J. W. Bennebaker (Eds.), *Handbook of Mental Control* (pp. 506-527). New York: Prentice Hall.

White, J. L., Moffitt, T. E., Caspi, D. J., Bartusch, D. J., Needles, D. J., & Stouthamer-Loeber, M. (1994). Measuring impulsivity and examining its relationship to delinquency. *Journal of Abnormal Psychology, 103,* 192-205.

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669-689.

Wing, R., Marcus, M., Epstein, L., Blair, E., & Burton, L. (1989). Binge eating in obese patients with Type II diabetes. *International Journal of Eating Disorders, 8,* 671-679.

Wiser, S., & Telch, C. F. (1999). Dialectical behaviour therapy for binge-eating disorder. *Journal of Clinical Psychology, 55,* 755-768.

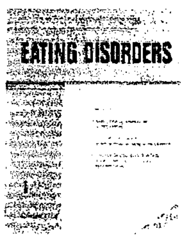
Wonderlich, S. A., Connolly, K. M., & Stice, E. (2004). Impulsivity as a risk factor for eating disorder behaviour: Assessment implications with adolescents. *International Journal of Eating Disorders, 36,* 172-182.

Zuckerman, B. (1971). Dimensions of sensation seeking. *Journal of Consulting and Clinical Psychology, 36,* 45-52.

APPENDICES

Appendix A

International Journal of Eating Disorders – Instructions to Authors



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Referencing in the text. Wiley's Journal Styles Are Now in EndNote (. EndNote is a software product that we recommend to our journal authors to help simplify and streamline the research process. Using EndNote's bibliographic management tools, you can search bibliographic databases, build and organize your reference collection, and then instantly output your bibliography in any Wiley journal style. If you already use EndNote, you can for this journal. To learn more about EndNote, or to purchase your own copy, . If you need assistance using EndNote, contact , or visit

Referencing follows the Vancouver method of reference citation. In this system, references are numbered consequtively in the order in which they are first mentioned in the text. Indentify each reference in text, tables, and legends by Arabic numbers. All references cited should be listed numerically at the end of the paper. Prepare citations according to the style used in Index Medicus and the International list of periodical title word abbreviations (ISO 833).

All reference citations in the text should appear in the reference list. When there are less than seven authors, each must be listed in the citation. When seven or more authors, list the first six followed by et al. after the name of the sixth author. Representative examples are as follows:
Journal Article: 1. Endicott J, Spitzer RL. A diagnostic interview: The schedule for affective disorders and schizophrenia. Arch Gen Psychiatry 1978;35:837-844.

Book Chapter: 2. Fairburn CG, Cooper Z. The eating disorders examination (12th ed). In: Fairburn CG, Wilson GT, editors. Binge eating: nature, assessment, and treatment. New York: The Guilford Press, 1993, p. 317-331.

Book: 3. Tudor I. Learner-centeredness as language education. Cambridge: Cambridge University Press; 1996.

Preparation of figures. To ensure the highest quality print production, your figures must be submitted in TIFF format according to the following

minimum resolutions:

- 1200 dpi (dots per inch) for black and white line art (simple bar graphs, charts, etc.)
- 300 dpi for halftones (black and white photographs)
- 600 dpi for combination halftones (photographs that also contain line art such as labeling or thin lines)

Vector-based figures (usually created in Adobeillustrator)shouldbesubmittedasEPS.Do not submit figures in the followingformats:JPEG,GIF,Word, Excel,Lotus1-2-3, PowerPoint, PDF.
Graphs must show an appropriate grid scale. Each axis must be labeled with both the quantity measured and the unit of measurement. Color figures must be submitted in a CMYK colorspace. Do not submit files as RGB. All color figures will be reproduced in full color in the online edition of the journal at no cost to authors. Authors are requested to pay the cost of reproducing color figures in print. Authors are encouraged to submit color illustrations that highlight the text and convey essential scientific information. For best reproduction, bright, clear colors should be used.

Supplementary materials. Supplementary materials will be made available to readers as a link to the corresponding articles on the journal's website.

PROPOSED ADDITIONAL GUIDELINES FOR COPYEDITING OF MANUSCRIPTS FOR INTERNATIONAL JOURNAL OF EATING DISORDERS

The *Journal* Editor and Associate Editors propose additional guidelines for manuscript copyediting in order to enhance consistency in the organization of printed material, and to bring *IJED* style in line with other major scientific publications. The key elements follow.

1. Each structured abstract should consistently use these subheadings (at present, the headings vary somewhat from article to article): Objective, Method, Results, Conclusion (this replaces Discussion).

2. Many of our Authors use terms such as "anorexics" or "bulimics" as personal pronouns, referring to groups of individuals by their common diagnosis. Henceforth, these terms should be replaced with more neutral language, as for example: "individuals with anorexia nervosa", "patients with bulimia nervosa", or "participants with eating disorders".

3. In the Methods section, the subheading "Subjects" should now be replaced with the subheading "Participants", and this term should be used in place of "subjects" throughout the text.

4. Standard rules will continue to govern the use of capitalization in Headings and Subheadings. However, when a minor word in a Heading or Subheading actually has special or unique meaning, the rule should be overridden.

5. When referring to gender, "males and "females" should be used in cases where the study samples include both children (below age 18) and adults; when the participants comprise adults only, the terms "men" and "women" should be used. In articles that refer to children (i.e., below the age of 13), "boys" and "girls" should be used.

6. *In articles that refer to genetic material, the names of genes should be spelled out in full the first time they appear in the text, after which an* italicized abbreviation can be substituted.

7. The word "data" is plural so text should follow accordingly; for example, "The data show...the data are ... the data were".

8. When an article references another article that appears in the very same issue of the *Journal* , (such occurrences are most likely in Special Issues), the citation will be updated by the copyeditor (i.e., volume number and pagination will be substituted for "in press").

9. In the Results section, *p* values should be carried to a maximum of three decimal places. A *p* value of 0.000 is never permitted. This section should also report mean values and standard deviations wherever appropriate, as well as effect sizes and confidence intervals, and tables should give the full meaning of any abbreviations used.

10. The Methods section should include a statement that the research was reviewed and approved by an institutional review board.

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??? Production Questions ???
Production Editor, EAT
Fax: (717) 738-9479
E-mail: jmlprodEAT@cadmus.com

Appendix B

Behaviour Research and Therapy – Instructions to Authors

Products
Behaviour Research and Therapy
Journal information
Product description
Editorial board
Audience
Abstracting/indexing
Subscription information
Bibliographic and ordering information
Conditions of sale
Dispatch dates
Journal-related information
Contact the publisher
Most downloaded articles
Other journals in same subject area
Related publications
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BEHAVIOUR RESEARCH AND THERAPY

An International Multi-Disciplinary Journal

Guide for Authors

For full instructions, please visit http://ees.elsevier.com/brat

Aims and Scope

Behaviour Research and Therapy encompasses all of what is commonly referred to as cognitive behaviour therapy (CBT). The major focus is on the following: experimental analyses of psychopathological processes linked to prevention and treatment; the development and evaluation of empirically-supported interventions; predictors, moderators and mechanisms of behaviour change; and dissemination of evidence-based treatments to general clinical practice. In addition to traditional clinical disorders, the scope of the journal also includes behavioural medicine. The journal will not consider manuscripts dealing primarily with measurement, psychometric analyses, and personality assessment.

The Editor and Associate Editors will make an initial determination of whether or not submissions fall within the scope of the journal and are of sufficient merit and importance to warrant full review.

Submission to the journal prior to acceptance Authors can submit their articles electronically via the Elsevier Editorial System (EES) page of this journal http://ees.elsevier.com/brat. The system automatically converts source files to a single Adobe Acrobat PDF version of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor's decision and requests for revision, takes place by e-mail and via the Author's homepage, removing the need for a hard-copy paper trail.

Online submission is strongly preferred but authors can, in special cases, also submit via mail. Four copies of the manuscript, including one set of high-quality original illustrations, suitable for direct reproduction, should be submitted to **Professor *G. T. Wilson, Psychological Clinic at Gordon Road, Rutgers, The State* University of New Jersey, 41C Gordon Road, Piscataway, New Jersey, 08854-8067, USA.** Email: brat@rci.rutgers.edu. (Copies of the illustrations are acceptable for the other sets of manuscripts, as long as the quality permits refereeing.)

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the Publisher.

Presentation of manuscript Please write your text in good English (American or British usage is accepted, but not a mixture of these). Italics are not to be used for expressions of Latin origin, for example, in vivo, et al., per se. Use decimal points (not commas); use a space for thousands (10 000 and above). Print the entire manuscript on one side of the paper only, using double spacing and wide (3 cm) margins. (Avoid full justification, i.e., do not use a constant right-hand margin.) Ensure that each new paragraph is clearly indicated. Present tables and figure legends on separate pages at the end of the manuscript. If possible, consult a recent issue of the journal to become familiar with layout and conventions. Number all pages consecutively.

Provide the following data on the title page (in the order given).

Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.

Author names and affiliations. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name, and, if available, the e-mail address of each author.

Corresponding author. Clearly indicate who is willing to handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address.**

Present/permanent address. If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract. A concise and factual abstract is required (maximum length 200 words). The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separate from the article, so it must be able to stand alone. References should therefore be avoided, but if essential, they must be cited in full, without reference to the reference list.

Keywords. Immediately after the abstract, provide a maximum of 6 keywords, to be chosen from the APA list of index descriptors. These keywords will be used for indexing purposes.

Abbreviations. Define abbreviations that are not standard in this field at their first occurrence in the article: in the abstract but also in the main text after it. Ensure consistency of abbreviations throughout the article.

N.B. Acknowledgements. Collate acknowledgements in a separate section at the end of the article and do **not**, therefore, include them on the title page, as a footnote to the title or otherwise.

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reports that are not suitable for publication as regular articles. Shorter Communications are appropriate for articles with a specialized focus or of particular *didactic value. Manuscripts should be between 3000 - 5000 words, and must not* exceed the upper word limit. This limit includes the abstract, text, and references, but not the title pages, tables and figures.

Arrangement of the article Subdivision of the article. Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text.' Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Appendices. If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: (Eq. A.1), (Eq. A.2), etc.; *in a subsequent appendix, (Eq. B.1) and so forth.*

Acknowledgements. Place acknowledgements, including information on grants received, before the references, in a separate section, and not as a footnote on the title page.

Figure legends, tables, figures, schemes. Present these, in this order, at the end of the article. They are described in more detail below. High-resolution graphics files must always be provided separate from the main text file (see Preparation of illustrations).

Specific remarks Tables. Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Be sparing in the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article.

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Citations in the text: Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications should not be in the reference list, but may be mentioned in the text. Citation of a reference as 'in press' *implies that the item has been accepted for publication.*

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Text: Citations in the text should follow the referencing style used by the American Psychological Association. You are referred to the Publication Manual of the American Psychological Association, Fifth Edition, ISBN 1-55798-790-4, copies of which may be ordered from http://www.apa.org/books/4200061.html or APA Order Dept., P.O.B. 2710, Hyattsville, MD 20784, USA or APA, 3 Henrietta Street, London, WC3E 8LU, UK. *Details concerning this referencing style can also be found at* http://humanities.byu.edu/linguistics/Henrichsen/APA/APA01.html.

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters "a", "b", "c", etc., placed after the year of publication.

Examples: Reference to a journal publication: Van der Geer, J., Hanraads, J. A. J., & Lupton R. A. (2000). The art of writing a scientific article. Journal of Scientific Communications, 163, 51-59.

Reference to a book: Strunk, W., Jr., & White, E. B. (1979). The elements of style. (3rd ed.). New York: Macmillan, (Chapter 4).

Reference to a chapter in an edited book: Mettam, G. R., & Adams, L. B. (1994). How to prepare an electronic version of your article. In B. S. Jones, & R. Z. Smith (Eds.), Introduction to the electronic age (pp. 281-304). New York: E-Publishing Inc.

Note that journal names are not to be abbreviated.

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Appendix C

Confirmation of Ethical Approval

Bown D

From: Smith K.M.
Sent: 07 June 2007
To: 'db105@soton.ac.uk'
Cc:
Subject: Ethics Application

Dear Debbie

Re: Impulsivity and Disordered Eating: Delay Discounting In Disordered and Non-disordered Eaters

The above titled application was approved by the School of Psychology Ethics Committee on 6 June 2007.

Should you require any further information, please do not hesitate in Contacting me. Please quote reference CLIN/04/52.

Yours sincerely

Kathryn
Secretary to the Ethics Committee

Appendix D

Participant Information/Consent

Consent Form & Information Sheet

Impulsivity and Eating Behaviour

My name is Debbie Bown, a trainee clinical psychologist from Southampton University. I am requesting your participation in a study regarding levels of impulsiveness in disordered and non-disordered eaters.

Participants who have been identified as fitting the criteria for this study will be asked to complete an experimental task. This will involve making some decisions as to which of two rewards you would prefer – an immediate smaller reward, or a delayed, larger reward, displayed on a computer screen. You will be asked to make your decision by pressing a computer key (relevant to your choice). You will be presented with approximately 30 decisions to make. A small monetary reward will be made relating to the decisions you make on the computerised task. Following this, you will be given a set of questionnaires to complete. The study will take approximately 50 minutes to complete.

Personal information will not be released to or viewed by anyone other than the researchers involved in this project. Results of this study will not include your name or any other identifying characteristics.

Your participation is voluntary and you may withdraw your participation at any time. If you choose not to participate there will be no consequences to your grade or to your treatment as a student in the psychology department.

A summary of this research project will be supplied to you upon request. To request a project summary, or if you have any questions, please contact me, Debbie Bown at db105@soton.ac.uk

Sincerely
Debbie Bown

Statement of Consent

I ..... have read the above informed consent form.

I understand that I may withdraw my consent and discontinue participation at any time without penalty or loss of benefit to myself. I understand that the data collected as part of this research project will be treated confidentially, and that the published results of this research project will maintain my confidentiality. In signing this consent letter, I am not waiving my legal claims, rights, or remedies. A copy of this consent letter will be offered to me.

(Circle Yes or No)

I give consent to participate in the above study. **Yes** **No**

Signed ..... Date .....

Name .....

I understand that if I have any questions about my rights as a participant in this research, or if I feel that I have been placed at risk, I may contact the Chair of the Ethics Committee, Department of Psychology, University of Southampton, SO17 1BJ, phone (023) 8059 3995.

Appendix E (i)

Participant Preliminary Instructions

PRELIMINARY WRITTEN INSTRUCTIONS

Monetary Reward Choices

In this experiment, you will undertake a fixed number of experimental trials in which you will be asked to indicate a choice preference between two different amounts of money. These amounts of money will each be available for you to collect after set amounts of time have passed.

It is up to you to consider how long you are prepared to wait in order to collect each amount of money whilst considering the value of each amount of money available for collection.

All money collected in the experiment, **except that collected in practice trials**, will be given to you to walk away with at the end of the experiment.

The experiment will take no longer than 30-40 minutes depending upon the choices you make, and will consist of two stages. Written instructions for each stage will be provided alongside the on-screen instructions. You will undertake four trials – (i) one practice trial for stage 1, (ii) one practice trial for stage 2, (iii) one actual trial for stage 1, and (iv) one actual trial for stage 2. Please read the instructions when you are prompted to do so on-screen.

Please take your time with the experiment and make your choices based simply on how long you are prepared to wait, given the size of the amount of money in question.

Finally, please do not hesitate to ask the experimenter any questions you may have at any time. If you are ready to begin, then please press the return key on the keyboard to continue.

Appendix E (ii)

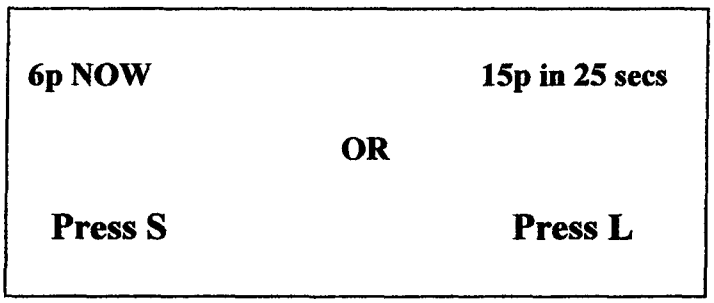
Practice Stage 1 Instructions

MONETARY REWARD CHOICES

PRACTICE TRIAL – STAGE 1

Instructions

The practice trial for stage 1 of the experiment will begin shortly. In Stage 1 you will be asked to make a choice between two amounts of monetary reward, one of which will each be available immediately and the other will be available for collection after a given amount of time. To select your choice, press the corresponding letter on the keyboard.



In this example, pressing 'S' will choose the immediate reward and pressing 'L' will choose the reward available after a given amount of time. If the immediate reward is chosen, then you will progress to the next trial. If the reward available after a time delay is chosen, then you will be presented with a countdown screen in which you must wait for the given amount of time before reward collection. You will then progress to the next trial.

Please take your time in making your choices. There are no right or wrong answers and there is no time limit within which to make your choice. You are simply asked to make your choices based on how long you are prepared to wait for the monetary reward in question.

You will now begin a small number of practice trials. Please note, money earned in these trials will **NOT** be given to you at the end of the experiment. The purpose of these trials is just to familiarise you with the experimental procedure.

If you have any questions, please ask the experimenter now. Otherwise, please press the spacebar to continue with the experiment.

Appendix E (iii)

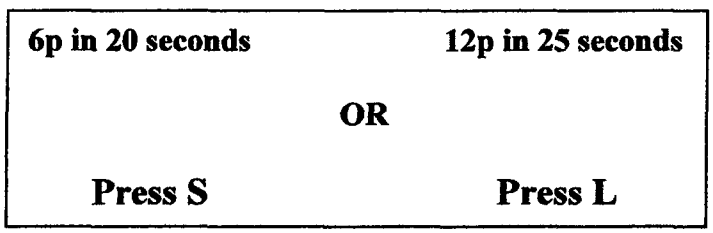
Practice Stage 2 Instructions

MONETARY REWARD CHOICES

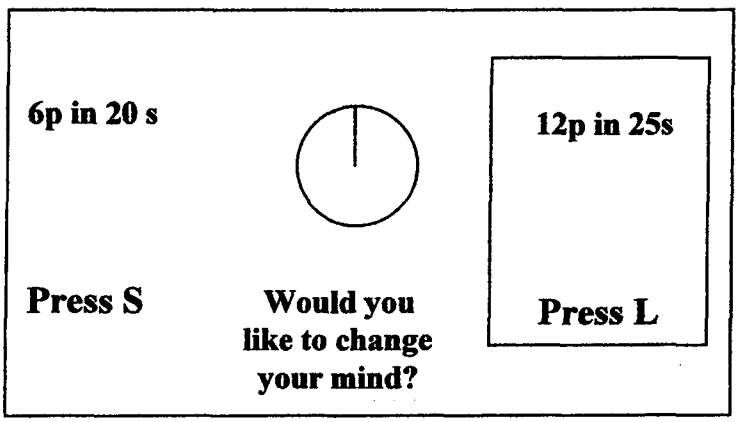
PRACTICE TRIAL – STAGE 2

Instructions

The practice trial for stage 2 of the experiment will begin shortly. In Stage 2 you will be asked to make a choice between two amounts of monetary reward, which will each be available for collection after a given amount of time. To select your choice, press the corresponding letter on the keyboard.



After a reward has been chosen on the first screen, a new screen will appear counting down the time until either reward can be received. The reward initially chosen will be highlighted by a red rectangle.



In this example, 12p in 25 seconds has been selected by pressing 'L' on the first screen. An **important difference** in Stage 2 is that you will be given the option of switching your selection. This is indicated by the question: "Would you like to change your mind?" If you change your mind about the monetary reward you would prefer as the timer is counting down, then you may re-select your preference as many times as you like by pressing the corresponding letter for the other reward. In the example given, the other option would be selected by pressing 'S'.

After the timer reaches zero seconds for the chosen reward, you will no longer be able to switch your selection and the chosen amount of money will be earned and you will proceed to the next trial.

If the larger reward is chosen and the smaller reward timer runs out, then a message reading 'Timed Out' will be displayed in place of the smaller reward. If this happens, you must wait for the remaining time until the larger reward is collected. You will then proceed o the next trial.

Whether you decide to switch your preference is entirely up to you. There are no right or wrong answers. You are simply asked to trust your judgements regarding how long you are prepared to wait.

You will now begin a small number of practice trials. Please note, money earned in these trials will **not** be given to you at the end of the experiment. The purpose of these trials is just to familiarise you with the experimental procedure.

If you have any questions, please ask the experimenter now. Otherwise, please press the spacebar to continue the experiment.

The on-screen instructions will advise you to call the experiment when the practice trials are completed.

Appendix E (iv)

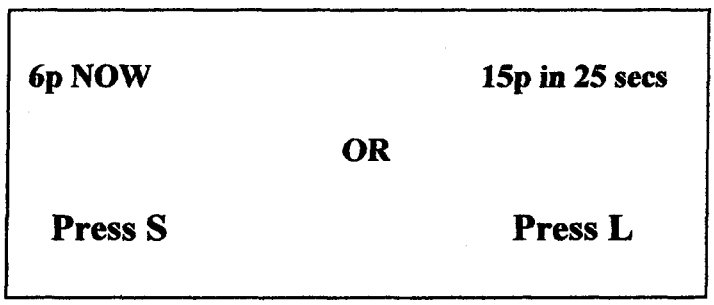
Actual Stage 1 Instructions

MONETARY REWARD CHOICES

ACTUAL TRIAL – STAGE 1

Instructions

You have now completed the practice trials. The actual trial for stage 1 of the experiment will begin shortly. Please remember, in Stage 1 you will be asked to make a choice between two amounts of monetary reward, one of which will be available immediately and the other will be available for collection after a given amount of time. To select your choice, press the corresponding letter on the keyboard.



In this example, pressing 'S' will choose the immediate reward and pressing 'L' will choose the reward available after a given amount of time. If the immediate reward is chosen, then you will progress to the next trial. If the reward available after a time delay is chosen, then you will be presented with a countdown screen in which you must wait for the given amount of time before reward collection. You will then progress to the next trial.

Please take your time in making your choices. There are no right or wrong answers and there is no time limit within which to make your choice. You are simply asked to make your choices based on how long you are prepared to wait for the monetary reward in question.

You will now begin the trial. Please note, from this point forward, all of the money earned will go towards a total, which will be given to you at the end of the experiment.

If you have any questions, please ask the experimenter now. Otherwise, please press the spacebar to continue with the experiment.

Appendix E (v)

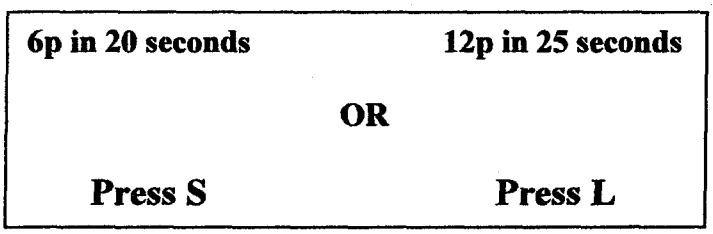
Actual Stage 2 Instructions

MONETARY REWARD CHOICES

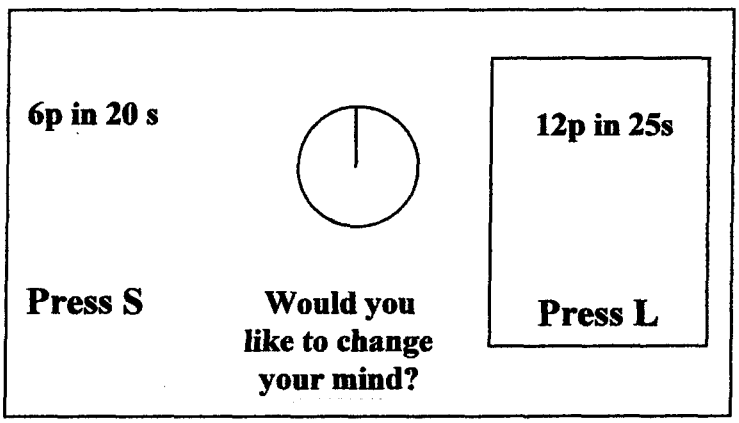
ACTUAL TRIAL – STAGE 2

Instructions

The actual trial for stage 2 of the experiment will begin shortly. Please remember, in Stage 2 you will be asked to make a choice between two amounts of monetary reward, which will each be available for collection after a given amount of time. To select your choice, press the corresponding letter on the keyboard.



After a reward has been chosen on the first screen, a new screen will appear counting down the time until either reward can be received. The reward initially chosen will be highlighted by a red rectangle.



In this example, 12p in 25 seconds has been selected by pressing 'L' on the first screen. An **important difference** in Stage 2 is that you will be given the option of switching your selection. This is indicated by the question: "Would you like to change your mind?" If you change your mind about the monetary reward you would prefer as the timer is counting down, then you may re-select your preference as many times as you like by pressing the corresponding letter for the other reward. In the example given, the other option would be selected by pressing 'S'.

After the timer reaches zero seconds for the chosen reward, you will no longer be able to switch your selection and the chosen amount of money will be earned and you will proceed to the next trial.

If the larger reward is chosen and the smaller reward timer runs out, then a message reading 'Timed Out' will be displayed in place of the smaller reward. If this happens, you must wait for the remaining time until the larger reward is collected. You will then proceed to the next trial.

Whether you decide to switch your preference is entirely up to you. There are no right or wrong answers. You are simply asked to trust your judgements regarding how long you are prepared to wait.

You will now begin trial two. Please note, money earned in these trials **will** be given to you at the end of the experiment.

If you have any questions, please ask the experimenter now. Otherwise, please press the spacebar to continue the experiment.

Appendix F

Debriefing/Information Sheet