IMPULSIVITY AND RISK-TAKING IN CLINICAL AND NON-CLINICAL POPULATIONS.

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Abstract

Various aspects of impulsivity, including risk-taking, were investigated by comparing the responses of control groups with those of three populations that were believed to exhibit problems with impulse regulation: those with eating disorders, attention deficit hyperactivity disorder (ADHD) and recreational drug users. Impulsivity was regarded as a multi-dimensional construct, tests were selected or developed to tap into various aspects of impulsivity, including self-report questionnaires, a novel discrete trials delayed reinforcement operant choice paradigm, a novel measure of financial risk-taking, and the continuous performance test which provides measures of both inattention and impulsivity. These tests varied in their ability to discriminate between groups, and the correlations between measures, as in previous studies, were typically low and mostly non-significant. Findings supported the proposal that impulsivity is a multi-dimensional construct that must be assessed using a wide range of measures including self-report questionnaires and more objective behavioural measures. The profile of effects found in the three targeted groups supported the proposal that impulsivity manifests itself differently in different populations. Women with anorexia nervosa scored low on impulsiveness and venturesomeness, and demonstrated behavioural impulsivity. Recreational drug users scored high on impulsiveness, venturesomeness and risk-taking, whereas ADHD individuals were inattentive and scored high on impulsiveness and risk-taking taking, but not venturesomeness.

Overall the findings highlight the complexity of the impulsivity concept and demonstrate the need to acknowledge its multi-dimensional nature by using a variety of tests to capture its variable expression. Whether impulsivity in particular groups reflects state or trait remains to be determined.

Declaration

I certify that this work has not been accepted in substance for any degree, and is not concurrently submitted for any degree other than that of Doctor of Philosophy (PhD) of the University of Greenwich. I also declare that this work is the result of my own investigations except where otherwise stated.

Signature of Student...

Signature of Supervisor..

Date..............7/05/2002...

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Contents

Chapter One.

Definition and measurement of impulsivity.

1.0 Introduction.

Impulsivity has become an important topic in psychiatric disorders and biological psychiatry over the recent years, although the concept of impulsive behaviour has been noted since the times of the ancient Greeks. As will become evident throughout this review the area of impulsivity (or impulsive behaviour) is one surrounded by a lack of consensus about what impulsivity is and how to measure it. This obviously raises issues when impulsivity forms either part of the diagnostic criteria for psychiatric disorders (DSM-IV, APA, 1994) or appears to be a characteristic element. Disorders of impulse control cover a wide variety of disorders, sometimes sharing only a single common characteristic, that of problems with impulse regulation.

The research reported in this thesis was conducted in order to investigate the role of impulsivity in a range of behaviours, and disorders where problems with impulse regulation are regarded as an important aspect either of the diagnostic criteria or the disorder. Consequently there are reasons to hypothesise that there might be problems with impulsivity or its antithesis, self-control, in the populations chosen: Attention deficit hyperactivity disorder (ADHD), eating disorders and drug use. This chapter reviews the general literature on impulsivity. Literature specific to the disorders and behaviours investigated are reviewed in chapter two.

1.1 Defining Impulsivity.

Since the early suggestion by Murray (1938) that impulsivity is the tendency to respond quickly and without reflection, it has become apparent that the term has wide currency in both psychology and psychiatry. However it is equally clear that there is a lack of consensus with regard to the precise definition of impulsivity, both within and between groups. The penguin dictionary of psychology defines impulsive as "A general term used of acts carried out without reflection or of the person prone to such acts" (Reber, 1985:348). The lack of reflection is common to both of the above definitions. However Skinner (1953) viewed the problems of impulse control not as a private conflict, but as a clash between the individual's wishes and those of society. Impulsivity has been defined in a variety of ways and as recently as 1995 Halperin, Newcorn, Matier, Bedi, Hall, & Sharma claimed that there was no universally accepted definition.

Barratt & Patton (1983) claimed that "impulsivity is an elusive and controversial concept among personality theorists, yet a concept that is widely used by clinicians and lay people alike" (Barratt & Patton, 1983:77). The lack of consensus with respect to the definition of impulsivity has also created problems for measuring impulsivity. As Block (1974), like Barratt and Patton (1983), noted the term impulsivity is used by different people, ranging from psychologists and psychiatrists to lay people, who may be mistaken in thinking that they are talking about the same concept when actually they maybe talking about different concepts. This confusion seems to have created more problems for impulsivity than its antithesis self-control.

A range of psychiatric disorders, including attention deficit hyperactivity disorder (ADHD), conduct disorder, drug and alcohol abuse and the eating disorder bulimia nervosa all share problems with impulse control as a common feature. The identification of problems with impulse control as a symptom of these disorders emphases a dysfunctional aspect of impulsivity. Whilst most of these disorders are characterised by too little impulse control the eating disorder anorexia nervosa can be characterised by too much control. Parasuicide is another behaviour that has been described as impulsive in nature and those who have attempted suicide have been found to score higher on a measure of impulsivity than psychiatric controls and non-psychiatric controls (Kashden, Fremouw, Callahan & Franzen. 1993). The DSM-IV (American Psychiatric Association, 1994) also contains a category of 'impulse control disorders not elsewhere classified', this includes, pathological gambling, pyromania, trichotillomania, intermittent explosive disorder and kleptomania. The impulse control disorders are characterised by a diminished capacity to delay or inhibit action, with the essential feature being a failure to resist an impulse, drive or temptation to perform some act that is potentially harmful to the person or others (DSM-IV, APA, 1994).

In addition to the aforementioned disorders impulsivity is also a symptom of DSM-IV axis II disorders such as Borderline Personality Disorder and

Antisocial Personality Disorder. Whilst impulsive behaviour in psychiatry and psychology is generally viewed as undesirable or dysfunctional, impulsive behaviour can be beneficial in certain situations. Problems arise when an individual takes it to either extreme, in that they behave with excessive self-control (such as individuals with anorexia nervosa) or impulsivity (as seen in bulimia nervosa and gambling), as this can lead to dangerous and risky behaviour.

The American Psychiatric Association diagnostic and statistical manual (DSM-IV) however has a limited view of impulsivity, in that it views impulsive behaviours as discrete and diagnosable syndromes. Whilst disorders classified by DSM-IV are all or none, in that the individual either has the disorder or does not, the same is not true for impulsivity. Impulsivity can be considered to exist on a continuum from self-controlled at one end of the continuum to impulsive at the other end, and to be normally distributed in the general population with most people engaging in impulsive or self-controlled behaviour at certain times. This is reflected in the behaviours engaged in by humans where there are wide individual differences in impulsivity, for example some people can diet, stop smoking or drinking whilst others cannot overcome these behaviours (Plutchik & van Praag, 1995). However whilst impulsivity can be considered dimensional rather than as a discrete entity, there can be cut off points with which to categorise an individual as being either impulsive or not, or self-controlled or not. Sohlberg (1991) suggests that the relationship between the two opposites of impulsivity, too little and too much control, are actually curvilinear and that "adaptive functioning requires a balance between expressing and holding back impulses" and that holding back too much is equally as maladaptive as too much expression (p191). Hollander (1998) on the other hand suggests that the opposite end of the impulsive dimension is compulsive behaviour. Hollander claims that impulsive and compulsive behaviour lie at opposite ends of the dimension of risk avoidance and that "impulsive individuals are risk seekers who try to maximise pleasure, arousal or gratification" (p7). Whether impulsivity is considered to be dimensional with either self-control at the other end of the continuum (or compulsive behaviour); or to be curvilinear, all of the above theories treat impulsivity as a dimensional rather than a discrete entity.

Not only can impulsivity be considered to be dimensional rather than a discrete entity, it has also been described by some, (Gerbing, Ahadi, & Patton,1987; Malle & Neubauer, 1991), as a multidimensional construct rather than a unidimensional one. There has been no general consensus on how best to define or measure impulsivity and the definition is usually dependent upon whether impulsivity is viewed as multidimensional or unidimensional. Definitions of impulsivity that are either implicitly or explicitly unidimensional include those focusing on one of the following: inability to withhold a response (Kagan, et al., 1964), acting on the spur of the moment, inability to tolerate delay or delayed gratification (Logue, 1988), and failure to look ahead to the consequences of behaviour. These various definitions of impulsivity might be regarded as reflecting different aspects or dimensions of the impulsivity construct. Petry (2001) suggests that impulsivity is a multidimensional construct which "...includes orientation toward the present, diminished ability to delay gratification, behavioural disinhibition, risk taking, sensation seeking, boredom proneness, reward sensitivity, hedonism and poor planning" (p30). These dimensions of impulsivity that Petry suggest are seen in different tests of impulsivity. Evenden (1999a) gives a number of definitions of impulsivity from different sources but proposes, like others, that there is not only one type of impulsive behaviour. Rather there are several related phenomena that Evenden terms 'varieties of impulsivity'. He suggests that these different 'varieties of impulsivity' lead to different types of impulsive behaviour. According to Schachar, Tannock and Logan (1993) "impulsiveness refers to behaviour under a very wide range of circumstances" (p736). Webster & Jackson (1997) however note that impulsivity is a behavioural expression and, regardless of the behavioural manifestation of impulsivity, individuals who are experiencing impulsive feelings describe them in much the same way. Thus suggesting some commonality between different impulsive behaviours.

Deficits in inhibitory control have been used to describe some types of impulsive behaviour. Schachar et al (1993) suggest that in circumstances which require the stopping of an action then individuals with deficient inhibitory control will appear impulsive. A deficit in inhibitory control leads to a greater likelihood that a response will not be controlled and will be executed. They suggest that inhibitory control is a cognitive construct and impulsiveness is a behavioural construct. They claim that deficient inhibitory control may contribute to some impulsive behaviour but not all. However they do not specify which impulsive behaviours result from poor inhibitory control.

1.2 Measures of Impulsivity and their relationship to each other.

As impulsivity is an important factor in many conditions, there have been numerous tools designed to measure it, these include self-report questionnaires measuring trait impulsivity, and behavioural or objective tests. Cattell (1957) described an objective task as any task that shows variance and can be objectively scored and whose purpose is indecipherable to the participant.

Some questionnaires have been designed specifically to measure impulsivity, such as the BIS of Barratt (1994), the I-7 of Eysenck, Pearson, Easting and Allsopp (1985), and the Impulsiveness Inventory of Dickman (1990). Other more general personality questionnaires such as the Guilford-Zimmerman Survey, the 16 Personality Factor Questionnaire, the Multi-dimensional Personality Questionnaire and the California Psychological Inventory, include a sub-scale to measure impulsive behaviour or self control. However Leucrubier, Braconnier, Said and Payan (1995) claimed that there are few instruments that aim specifically to measure impulsivity and therefore they developed the Impulsivity Rating Scale (IRS). The IRS is a seven item self-report questionnaire that according to the authors takes into account the heterogeneity of impulsivity. The seven items that the IRS assesses are different behaviours that are commonly involved in impulsivity. These seven items measure impulsivity in usual life situations over the past week, and of these seven items only one is subjective. Whilst this may be measuring impulsivity more objectively it is subject to the same problem that all self-report questionnaires have, that of verification of the honesty with which they are answered.

Many of the behavioural tests of impulsivity measure speed of response, these include the Matching Familiar Figures Test (Kagan et al, 1964), draw a line slowly (DALS; Bentler & McClain, 1976), walk a line slowly (WALS; Olson, Bates, & Bayles, 1990) and the reaction time tasks, of which there are numerous variations. Latency to complete questionnaires has also been another speed of response measure (Moltó, Segarra & Avila, 1993; Elliot, Lawty-Jones & Jackson, 1996). On tasks measuring speed of response impulsives are characterised by fast responding. Two other measures often used are time based, these are time estimation and time production (Barratt & Patton, 1983; Gerbing et al., 1987). In time estimation tasks participants are required to estimate the length of time that has elapsed whereas in time production they are required to produce a set amount of time, i.e. say when 30 seconds has passed. Impulsive people tend to overestimate how much time has elapsed and under produce time.

Milich & Kramer (1984) reviewed behavioural (objective) measures of impulsivity such as the porteus maze test, draw a line slowly (DALS), walk a line slowly (WALS) and a cognitive measure the Matching Familiar Figures Test (MFFT). The MFFT is a commonly used measure of impulsivity which involves 'a matching to sample task' and generates an error score and latency to first response score. Impulsives are characterised by fast and inaccurate responding, that is they have short latencies to first response and make more errors than non-impulsives (Kagan et al, 1964). The MFFT is however not without its critics (Block et al, 1974). Milich & Kramer (1984) summarised that many of the laboratory measures of impulsivity are based on impulsive behaviour that includes the tendency to exercise insufficient control, rapid responding, and making errors. After reviewing studies of impulsivity Milich & Kramer noted that none of them resolved whether a generalised construct of impulsivity exists. They also reported that there were methodological problems with many of the studies and that the findings suggest that there may be more than one type of impulsivity. They termed these cognitive and social impulsivity.

In 1980 Paulsen and Johnson recommended that due to the broadness of the term impulsivity, an assessment of impulsivity should cover more than one behaviour, thus suggesting that it was multi-dimensional. This however does not occur very frequently and many studies continue(d) to assess impulsivity using either a single subjective measure or a single objective measure of impulsivity. Some clinical studies measure impulsivity based on the number of impulsive behaviours that an individual engages in, and this is also how Lacey & Evans (1986) assess their multi-impulsive personality disorder. The view of Paulsen and Johnson is supported by the research of Gerbing et al. (1987) and others (see below). Wingrove & Bond, (1997) also note the lack of associations between the trait measures and behavioral measures of impulsivity and claimed that "The uncertainty about how impulsivity should be defined and therefore what constitutes an appropriate operationalization makes it impossible to argue that either measure is invalid" (p334).

Bachorowski and Newman (1985) investigated the relationship between trait impulsivity and motor speed. The motor speed task consisted of participants tracing a circle under neutral conditions, where no instructions as to the speed of tracing were given, and then under inhibition where they were asked to trace as slowly as possible. This can be considered a behavioural or objective measure of impulsivity and a variant of draw a line slowly. Trait impulsives did not differ from non-impulsives with regards to speed of tracing on the neutral task, but were significantly faster on tracing on the inhibition task. Wallace and Newman (1990) also compared circle drawing latency in high and low impulsives. High impulsives were classified as such by being neurotic extraverts according to the theory of Eysenck. Low impulsives on the other hand were stable introverts. Eysenck & Eysenck (1991) described the typical extravert as craving excitement, taking chances, "...acting on the spur of the moment, and is generally an impulsive individual" (p4). The introvert on the other hand is not impulsive and looks before leaping. Wallace & Newman (1990) used an inhibition tracing task with a goal, where the point to stop tracing was clearly marked on the circle template. This differed from Bachorowski & Newman's study, in that there was no neutral tracing, but participants were required to trace a circle as slowly as possible three times. Wallace and Newman found that high impulsives had significantly faster tracing times than low impulsives on both a goal task and under the presence of reward cues.

Gerbing et al (1987) investigated the construct of impulsivity in a sample of 229 using 12 self-report scales of impulsivity and 4 behavioural measures. Some of the self-report scales were from questionnaires specifically designed to measure impulsivity (I-5; BIS-10) whilst others were impulsivity scales from general personality questionnaires. The behavioural measures used were those measures that are commonly used to assess impulsivity, these were the MFFT, simple reaction time, time estimation, and time production. They identified 15 distinct impulsivity components with moderate to low correlations. These consisted of 12 self-report and 3 behavioural components. In general, correlations between the self-report factors were low, with the largest correlation between the impulsivity factors being 0.60 and with only 5 correlation coefficients between 0.5 and 0.6. Gerbing et al (1987) also found that the correlations between self-report and behavioural measures were low. This theme of low intercorrelations between the factors of impulsivity was also apparent between the 3 behavioural measures, with the highest correlation being only 0.33. Based on these findings Gerbing et al. reported that these weak correlations between the behavioural and the self-report measures demonstrate that studies that operationalize impulsivity with either a single self-report measure or a single behavioural measure are probably investigating different constructs to each other. In addition to being in agreement with Gerbing et al. another factor which needs to be borne in mind is that some behavioural measures of aspects of impulsivity may actually be in opposition to one another, such as where risk seeking behaviour might require a delayed response. This can be seen with the Walsh Test (Walsh, unpublished) which is outlined in chapter five.

Parker & Bagby (1997) also compared behavioural measures of impulsivity with three self-report scales from general personality questionnaires in a sample of 50 undergraduates. The behavioural measures used were the MFFT, time estimation and time production tasks. Parker & Bagby (1997) reported that the three impulsivity scales were significantly correlated (0.78-0.89). There was a negative correlation between time estimation and time production tasks, those who overestimated the amount of time that had elapsed in time estimation also signalled earlier to indicate that a specific time had passed in time production. The two MFFT scores latency and errors only correlated with each other. Their findings on the relationship between the three behavioural measures were in line with those of Gerbing et al (1987) who found no relationship between either of the MFFT scores and either time estimation or time production. These results suggest that either the self-report measures are measuring a different aspect of impulsivity to the behavioural measures, or participants may not be responding honestly on the self-report questionnaires. Furthermore the consistent lack of correlations between the MFFT and other behavioural measures may reflect Block, Block & Harrington (1974) criticisms that the MFFT is not measuring impulsivity, and that the construct of impulsivity is "too broad for any one measure to represent" (p631).

Whilst studies thus far report either low or non-significant correlations between the self-report questionnaires and behavioural measures of impulsivity, two studies have found significant negative correlations between questionnaires and latency to complete the questionnaire. Moltó et al, (1993) found that individuals who completed questionnaires faster (had shorter questionnaire response latencies) also had higher scores on the I-6 (the junior version of the I-7) than those classified as slow responders. The criterion used to classify fast and slow responders was one standard deviation above or below the mean. The difference on scores on the impulsiveness scale between slows and fasts was statistically significant. In a similar vein Elliot, Lawty-Jones & Jackson (1996) reported a significant negative correlation between the impulsiveness scale of the I-7 and questionnaire response latencies. Thus suggesting a relationship between questionnaire response latencies and impulsivity as assessed by Eysenck's self-report trait measure of impulsivity.

Malle & Neubauer (1991) however reported no relationship between the MFFT, a German self-report impulsivity questionnaire (the MIS, which contains items from the I-5 & BIS) and questionnaire response latencies. There was however a correlation between MFFT latency (time to first response) and questionnaire latencies for males but not for females (r=0.41). The authors suggested that "aspects of impulsivity should be grouped into a behavioural and a self-report domain. Also within these domains, heterogeneous facets exist" (Malle & Neubauer, 1991:869). Carrillo-de-la-Peña, Otero and Romero (1993) used principal component factor analysis to explore whether there were different dimensions within impulsivity. Carrillo-de-la-Peña et al., reported a self-report factor which consisted of the impulsiveness scale from the I-6 (Eysenck, Easting and Pearson, 1984) and the Barratt Impulsiveness Scale (Barratt, 1985). The second factor included MFFT latency and error scores, thus supporting Malle & Neubauer's assertion that the different aspects of impulsivity should be grouped into a self-report and a behavioural domain, and further supporting the lack of correspondence between the MFFT and other measures of impulsivity. In a review of the animal and human literature on impulsivity, Evenden (1999b) concludes "that impulsivity is multifactorial and that these factors are separable and independent of one another" (1999b:1989). Evenden also points out that in view of the multifactorial nature of impulsivity, there is no reason to suppose that such diverse tests should correlate. Evenden's view is supported by the consistent low and /or non-significant correlations between the different measures of impulsivity reported above.

Wingrove and Bond (1997) used both a trait measure of impulsivity (I-7), and behavioural measures. The behavioural measures were circle tracing, both a neutral and an inhibition condition, time production and time estimation tasks. They reported a correlation between the neutral tracing task only, time estimation and time production tasks, with shorter tracing times correlating with overestimating time and under producing time. However neither of these tasks nor the inhibition-tracing task correlated with the trait measure. They conclude that this is not surprising given the consistent lack of correlation between trait and behavioural measures of impulsivity previously reported.

A further problem in the assessment of impulsivity arises from how impulsivity is conceptualised. As noted earlier it is generally agreed that impulsivity is a multidimensional construct. However some of the measures, both self-report and behavioural, only measure a narrow aspect of impulsivity, thus treating it as a unidimensional construct. As noted by Parker and Bagby (1997) many measures of impulsivity assess a cross section of the dimensions of impulsivity, whereas others only assess a narrow aspect. It is likely that many of these self-report measures tap into more than one dimension of impulsivity whereas the behavioural measures are likely to assess only a single dimension. This might explain the lack of correlation between the self-report measures and the behavioural measures, and the lack of correlations between the behavioural tasks. Correlations that are generally found are those between time estimation and time production, and between different reaction time tasks. Each of which could be considered to be measuring different aspects of impulsivity.

1.3. Delayed reinforcement (or discounting of delayed rewards) as a behavioural measure of impulsivity.

One objective or behavioural measure used to assess impulsivity is within an operant choice paradigm (a delayed reinforcement paradigm). Impulsivity is defined in a choice paradigm as the choice of a smaller immediate reinforcer over a larger later reinforcer. Whereas self-control is defined as the choice of the larger later reinforcer over the smaller immediate reinforcer (Logue, 1988; Ainslie,1975). This is known as delayed reinforcement and has been studied extensively in animals.

The literature on operant choice paradigms with non-humans, generally rats or pigeons, report that it is difficult to demonstrate self-control in this situation when the animals are responding for food reinforcement. There are a number of models of why this behaviour occurs, most of which will not be discussed here. Ainslie (1975) proposed that the probability that the impulsive choice will be made is a direct function of the relative magnitude of the reinforcer and an inverse function of the relative delay to the reinforcer. To explain impulsiveness in a choice paradigm Ainslie (1975) suggests that there needs to be not only discounting of delayed events, but also a reversal of choice. Moreover he suggests different reinforcers become ineffective at different rates when they are delayed.

The relative effectiveness of alternative reinforcers can shift simply as a function of passing time.

In contrast to the animal literature, the literature on humans, with the exception of children (Schweitzer & Sulzer-Azaroff, 1988) and adolescents with special educational needs (Ragotzy et al., 1988), report that it is difficult to demonstrate impulsivity in a delayed reinforcement task. Sonuga-Barke (1996) reported that by the age of six children show self-control in a choice paradigm. Impulsive choice behaviour is more likely to be exhibited in human adults when negative reinforcement is used rather than positive reinforcement (Navarick, 1998). One reason for the apparent differences between animals and humans might be the tendency for primary (or immediate) reinforcers to be used with animals and secondary reinforcers to be used with humans.

The intrinsic nature of the reinforcer appears to be an important factor affecting choice behaviour, with primary or immediately consumable reinforcers generating more impulsive behaviour than secondary reinforcers (Forzano and Logue 1994). Forzano & Logue (1994) found that responding for juice available during the session generated impulsive behaviour, whilst both points exchangeable for money and points exchangeable for juice at the end of the session generated more self-controlled behaviour. There were no differences between responding for either points exchangeable for money or points exchangeable for juice at the end of the session. These results demonstrate that reinforcers which are immediately consumable seem to generate more impulsive behaviour than secondary reinforcers, which are exchangeable at the end of the session. This may be due to the additional delay involved when secondary reinforcers are used, i.e. the delay to actually receiving the primary reinforcer, which does not occur until the end of the session at the earliest. This interpretation is supported by the results of Miller & Navarick (1984) who reported impulsive responding when an immediately consumable positive reinforcer, access to a video game was used. Another key feature of delayed reinforcement tasks is the role of the passage of time, the time between the response and the reinforcer (Ho et al, 1998).

Reinforcement densities are another factor which have an effect on choice responding. An effect of reinforcement densities may be seen, especially when choosing the smaller more immediate reinforcer results in more overall reinforcement (Logue et al., 1990). Logue et al (1986) found that when choosing the smaller more immediate reinforcer (responding for points exchangeable for money) resulted in more overall reinforcement then these participants were classified as impulsive. However Logue et al (1986) suggest that humans may show molar self-control and by choosing the smaller more immediate reinforcer in their study participants were self-controlled as they made the choice which maximised reinforcement. If reinforcement densities are kept equal between the two choices then choosing the smaller immediate reinforcer can be conceptualised either as behaving impulsively or as an inability to delay gratification or tolerate delay and not as maximisation of reinforcement.

Sonuga-Barke, Williams, Hall, & Saxton (1996) used an operant choice paradigm and suggested that impulsiveness should be defined at a more molar level, as the more often the smaller less delayed reinforcer is chosen then the shorter the session will be. They claim that due to this it does not make sense to term the choice of the smaller less delayed reinforcer over the larger later reinforcer as impulsive. Sonuga-Barke, Houlberg, & Hall (1994) suggested that those individuals who choose the smaller less delayed reinforcer over the larger later reinforcer are not impulsive but rather delay averse. Claiming that impulsivity is a sensitivity to pre-reward delay whereas delay aversion is a sensitivity to overall delay levels. However if choice of the smaller immediate reinforcer results in both less pre-reward delay on each trial and a shorter session overall it is impossible to separate out the two factors, and a shorter session may just be a consequence of sensitivity to pre-reward delays. An alternative to this is that if reinforcement densities were kept equal then there would be no shorting of session times by choosing the smaller less delayed reinforcer, and what would be different between the two choices would be pre-reinforcement delays and magnitude of individual reinforcements.

To overcome the problem of choosing the smaller immediate reinforcer resulting in shorter session times, Schweitzer & Sulzer-Azaroff (1995) imposed equal trial length between the two choices by adding a post reinforcer delay to both conditions. This condition ensured that choice was independent of session length and also that trial length was equal regardless of the choice the individual made. This condition resulted in choosing the larger later reinforcer being maladaptive in that less reinforcement was earned. So whilst controlling for session length and making choice independent of session length, Schweitzer & Sulzer-Azaroff did not control for reinforcement densities. As the same amount of reinforcement was not available per session for each of the choice options. However even though choosing the small immediate reinforcer resulted in less overall reinforcement, children (5 & 6 year olds) with ADHD behaved impulsively. The ADHD group were also more impulsive than the age matched controls. Furthermore the control group showed more preference for the larger later reinforcer across time whilst the ADHD group showed more preference for the smaller immediate reinforcer. An operant choice paradigm therefore appears to be sensitive to differences between groups.

Cherek, Moeller, Dougherty & Rhoades (1997) used the BIS-11, the Impulsivity Inventory (Dickman, 1990) and a self-control choice paradigm to measure impulsivity in violent and non-violent male parolees. The groups of violent and non-violent were assigned based on the man's criminal history (i.e. whether the crime was classified as violent in nature or not). Cherek et al (1997) found that the violent parolees made significantly more impulsive choices on the self-control task, which was choosing the smaller more immediate reinforcer (5 cents after 5 seconds) over the larger delayed reinforcer (15 cents delivered after 15 seconds). However by making the impulsive choice the violent group had shorter session times but more sessions and the authors acknowledge that session length may have had an effect on choice for this group, but note that this is unlikely as testing took part on one day only and no information was given about the number of trials per session or the number of testing sessions. The violent parolees also had significantly higher scores on the BIS-11 total score than the non-violent group, and for all parolees the number of impulsive choices on the self-control paradigm was significantly correlated with BIS-11 impulsivity. This is a rare example of a self-report measure of impulsivity correlating with a behavioural task.

A common factor in the operant choice studies discussed above is that reinforcement densities were not kept equal between the two choices. This then calls into dispute whether choosing the smaller immediate reinforcer is actually impulsive when it results in more overall reinforcement for the session. To overcome this issue reinforcement densities between the two choices need to be equal for the session. Then the choice an individual is left with is between a larger number of smaller immediate reinforcers or a smaller number of larger delayed reinforcers.

Navarick (1998) suggests that impulsivity requires a more multidisciplinary approach, and that "...correlations between personality assessment data and choice data would afford insights into the kind of processes at work both in the laboratory and in the environment" (p.674). As Evenden (1999a) points out researchers working within the different areas of impulsivity, such as the personality trait of impulsivity, the experimental analysis of impulsive behaviour or impulsivity within psychiatry rarely cite one another's work.

1.4. Theories of impulsivity.

Not only do we have different definitions of impulsivity but also different theories. Impulsivity can be viewed as a personality trait, as a cognitive style or as a situation specific behavioural expression or state. As Plutchik & van Praag (1995) point out most of the literature tends to view impulsivity as a personality trait, rather than as a state. Whiteside & Lynam (2001) claim that impulsivity appears, in one form or another, in every major system of personality. Plutchik and van Praag (1997) suggest that impulsivity "is a generalised trait influenced by family experiences, social stessors, drug use, and genetics (and) is generally found as a socially dysfunctional trait" (106). They also point out that psychiatrists are generally interested in impulsivity as a dysfunctional condition instead of as a normal personality trait.

One theory that explicitly views impulsivity as a personality trait is that of Eysenck & Eysenck (1978). Impulsivity is linked to their 3 dimensional theory of personality which is based around the traits of extraversion, neuroticism and psychoticism. They considered impulsivity as one of the major factors making up extraversion. Impulsivity and sensation seeking behaviour are considered to form a large part of the factor extraversion. The psychoticism dimension also includes elements of risk-taking and sensation seeking. Consequently a separate impulsivity scale was designed, the I-5, which contained two scales to measure impulsivity (Eysenck & Eysenck 1978). These were termed impulsiveness, which they claim is related to psychoticism, and venturesomeness which is more related to extraversion. Impulsiveness also correlated positively with neuroticism whereas venturesomeness correlated negatively with neuroticism. This was revised by S.B.G. Eysenck, Pearson, Easting & Allsopp (1985) into the I-7. Buss (1988) notes that traits such as impulsivity do not occur in isolation and that the combination of impulsivity and sociability creates extraversion. Impulsivity is hypothesised to be due to low cortical arousal, which in turn is due to poor functioning of the reticular activating system.

> "Arousal activates the cortex, which inhibits the activity of lower clusters; if arousal is lowered, inhibition is removed, allowing impulsive behaviours to occur with greater freedom" (H.J. Eysenck, 1993:65).

Stimulant drugs increase arousal and depressant drugs reduce it (Eysenck, 1993). This can be seen with the effect of psychostimulant drugs (e.g. methylphenidate) used to treat children with ADHD, these drugs reduce behavioural impulsivity (Eysenck & Gudjonsson, 1989) but increase cortical arousal. This might explain the apparent paradox of prescribing a stimulant drug to someone who is impulsive and overactive.

Dickman (1990) is another who views impulsivity as a personality trait. Unlike the psychiatrists who are generally interested in impulsivity as a dysfunctional condition Dickman (1990) proposed that there are two distinct types of impulsive personality trait, functional and dysfunctional. Both functional and dysfunctional impulsivity are characterised by a tendency to act with relatively little forethought. Whilst functional impulsives act with relatively little forethought due to being rewarded for such behaviour, dysfunctional impulsives act despite their impulsive behaviour resulting in negative consequences. This view of Dickman's may suggest that dysfunctional impulsives are insensitive to reward and suggests that not all impulsive behaviour is maladaptive. Dickman's self-report questionnaire contains two scales, a functional and a dysfunctional impulsivity scale. Individuals who score high on the functional scale do not tend to score high on the dysfunctional scale, supporting Dickman's theory that there are two distinct types of impulsivity. Functional impulsivity is characterised by lively and adventurous behaviour and the willingness to take risks. Dysfunctional impulsives are characterised by the "tendency to engage in rapid, error-prone information processing because of an inability to use a slower...approach under certain circumstances" (Dickman, 1990, p101). Dickman's functional scale bears some resemblance to Eysenck's venturesomeness scale and the dysfunctional scale to impulsiveness, which is aligned with extraversion.

Brunas-Wagstaff, Bergquist, Richardson and Connor (1995) reported that functional impulsivity correlated positively with Eysenck & Eysencks' (1978) personality traits psychoticism and extraversion, and negatively with neuroticism. In contrast the only significant correlation for dysfunctional impulsivity was positively with extraversion. Brunas-Wagstaff et al., (1995) report that as both functional and dysfunctional impulsivity were positively correlated with extraversion this supports Eysenck's theory that impulsivity is a sub-component of extraversion and this appears to be so regardless of whether the impulsive behaviour is beneficial for the person or not.

Another researcher who views impulsivity as a personality trait is Barratt who proposed 3 factors to impulsivity: motor, cognitive and non-planning (Barratt & Patton, 1983). Motor impulsiveness involves acting without thinking, cognitive impulsiveness involved quick cognitive decisions and non-planning involved a lack of concern for the future. The BIS-10 (Barratt Impulsivity Scale) was devised by Barratt to measure the three traits of impulsivity specified above. The BIS has been through numerous revisions and versions since the original in 1968 with the current version being the BIS-11 (Patton, Stanford & Barratt, 1995). Factor analysis of the data available suggested that the BIS-11 also contains three subtraits of impulsivity. These are an 'ideo-motor' impulsiveness subtrait, a 'careful planning' subtrait, and a future-orientated 'coping stability' subtrait. (Barratt, 1994). Barratt claims that the careful planning subtrait of the BIS-11 is related to cognitive style and he continues to maintain that there is a cognitive impulsiveness factor. However such a factor is difficult to measure: to what extent are people able to assess their own cognitive functions, especially impulsive individuals? This probable lack of insight, especially with the mentally ill, is problematic for all the self-report questionnaires of impulsivity.

Using the BIS-11 to measure impulsivity and its relationship with risk-taking in an adolescent and young adult population Stanford, Greve, Boudreaux, Mathias and Brumbelow (1996) found that high impulsives engaged in more risk-taking behaviour than low impulsive individuals. Risk-taking behaviour was assessed as the rate at which participants reported engaging in behaviours such aggression (fighting), drug use, drunk driving and lack of seatbelt use. These findings support the earlier notion that risk taking behaviour is either an aspect of impulsivity or that impulsive individuals engage in risky behaviours.

Barratt and Patton (1983) have claimed that impulsivity includes both cognitive and behavioural aspects. They drew two main findings from their work with the BIS and other impulsivity measures. These were as follows:

(1) Most questionnaires of impulsivity are significantly intercorrelated.
(2) The questionnaire measures of impulsivity usually have low and non-significant correlation with non-questionnaire measures of impulsivity.

They suggest that definitions of impulsivity are on shaky grounds if they are restricted to questionnaire measures only and posed a question that remains unanswered today, "whether or not there are common underlying dimensions in the various impulse control pathologies" (Barratt & Patton, 1983:80). This emphasises the need for objective measures of impulsivity to be used in conjunction with the questionnaires, and for there to be more than one measure used if the different aspects of impulsivity are to be assessed. Furthermore it highlights the need for an investigation of impulsivity to include more than one population. From trait theories of impulsivity such as Barratt & Patton, (1983), Dickman, (1990) and, Eysenck & Eyenck (1977) which apply to all populations, Lacey & Evans (1986) suggested an impulsive personality type in those with clinical disorders.

1.5 The concept of a multi-impulsive personality.

Lacey & Evans (1986) suggested that there is impulsive behaviour in disorders such as substance abuse, and eating disorders, and within these clinical populations there are significant numbers of patients who engage in more than one type of impulsive behaviour. They proposed that such patients have what they termed a multi-impulsive personality disorder.

Lacey and Evans (1986) further talk of links between bulimia nervosa and other disorders where impulse regulation is a problem, such as gambling. They note that control is a common goal in both bulimia and gambling, and Custer (1984) has called gambling a drugless impulse disorder. Breen & Zuckerman (1999) suggest that impulsivity contributes to gambling problems. Lacey & Evans (1986) suggest that for some individuals with eating disorders there are multiple patterns of impulsivity and that there is an overlap with substance abuse disorders and binge eating. Both of these are associated with poor prognosis and parasuicide, which has also been linked with impulsive behaviour. Lacey & Evans's criteria for a multi-impulsive form of bulimia is when bulimia is associated with one of alcohol abuse, illicit drug abuse, multiple overdoses, repeated self-harm or shoplifting. Furthermore they suggest that these individuals have a multi-impulsive personality disorder, or in relation to bulimia it is multi-impulsive bulimia.

A study investigating the relationship between substance abuse and impulsivity as assessed by the impulsiveness scale of the I-7 (Eysenck et al., 1985) supported Lacey & Evans multi-impulsive personality disorder (McGown, 1988). McGown reported that multiple substance abusers scored higher on impulsivity than single substance abusers. However McGown also noted that whilst the results support the notion of a multi-impulsive personality disorder, it is unclear whether impulsiveness leads an individual to take addictive agents or whether impulsiveness is a covariant of a personality that is associated with a vulnerability to addiction. In another study investigating gambling behaviour a positive relationship was found between impulsivity and the severity of gambling in substance abusers (McCormick, 1993). These results also suggest that impulsive behaviours can co-occur. However it is unclear whether impulsivity leads to behaviours such as substance abuse and gambling or whether substance abuse lead to impulsivity, possibly through some changes in neurotransmitter functioning.

Kennedy and Grubin (1990) also investigated Lacey & Evans (1986) argument for a multi-impulsive personality disorder. Kennedy & Grubin (1990) proposed that if there is a multi-impulsive personality disorder then individuals with multiple disorders should be distinguishable from others using a measure of impulsivity that was independent of the disorders. Alternatively they hypothesised that impulsivity may be continuously distributed in the population and individuals at the impulsive end of the spectrum may simply be more likely to have more disorders than individuals who are lower down on the continuum. The second hypothesis of Kennedy and Grubin (1990) suggests that higher impulsivity leads to cross situational impulsive behaviour, whereas those who score lower on a measure of impulsivity may only behave impulsively in one domain. Their hypotheses were investigated using a population in whom it might be expected that impulsive behaviours or disorders occur more frequently, a prison population. Impulsivity was assessed using a self-report questionnaire, designed to specifically measure impulsivity the I-5, an earlier version of the I-7 (Eysenck & Eysenck, 1978). They reported that impulsiveness was related to the number of disorders of impulse control in convicted sex offenders. Behaviours measured included alcohol abuse, sedative dependence, drug abuse, pathological gambling, repeated aggression and self-harm. Whilst there was a linear correlation between impulsiveness scores and the number of impulse control disorders, Kennedy and Grubin (1990) maintain that their results do not support the notion of a multi-impulsive personality disorder, "...but simply demonstrate the truism that impulsive people do impulsive things" (642). Alternatively what their results might suggest is that those individuals in their sample who had multiple disorders may merely represent one end of a continuum, on a continuous impulsivity spectrum, which is what they alternatively hypothesised.

Stanford & Barratt (1992) followed on from the research of McGown (1988) and Kennedy & Grubin (1990) and further investigated the notion of a multi-impulsive personality disorder in male prisoners. Unlike Kennedy & Grubin, whom the authors claim used a global measure of impulsivity, they proposed to be measuring impulsiveness subtraits as well. The measure of impulsivity used was the BIS-10. Whilst this generates scores from 3 subscales that measure impulsivity (plus a total score) it however has its weakness in still relying on a single self-report measure. Stanford & Barratt (1992) reported that only the motor impulsiveness scale correlated significantly with the number of impulse control disorders, and claim that these results support the notion of a multi-impulsive personality disorder. Alternatively the results of Stanford & Barratt (1992) may reflect that those who act without thinking, which is what motor impulsiveness is considered to measure (Barratt & Patton, 1983) do so in more than one situation.

Stanford, Ebner, Patton and Williams (1994) provided further support for the notion of a multi-impulsive personality using an adolescent psychiatric population. For this group the number of impulsive behaviours displayed was related to the total score on the Pyschopathy Checklist Revised (PCL-R; Hare et al., 1990) which the authors reported to be 'a measure of behavioural impulsiveness'. However this is not a measure of impulsivity, but of psychopathy that assesses 20 behaviours, with poor behavioural control and impulsivity being two of the behaviours assessed. Whilst impulsivity does appear to be a component of psychopathy, a psychopathy questionnaire is not a measure of impulsiveness. Helmers, Young, & Phil (1995) reported a positive correlation between the Hare Psychopathy checklist and Eysenck's impulsiveness in healthy male volunteers. In general there seems to be some support for the notion of a multi-impulsive personality disorder. This notion of a multi-impulsive personality disorder fits in with the continuum view of impulsivity, from no impulsive behaviour (self-controlled) through to a single domain specific type of impulsive behaviour to multiple impulsive behaviours in different domains. However it may just reflect what Kennedy & Grubin claimed, that impulsive people engage in impulsive behaviours and perhaps the more impulsive a person is the more impulsive behaviours they exhibit.

1.6. Impulsivity: a state or a trait?

Whilst there are different trait theories on impulsivity Wingrove and Bond (1997) suggest that impulsivity should be investigated as a state as well as a trait, as individuals may not behave impulsively at all times. This supports the view that impulsivity may be domain specific and not a stable personality trait across situations. They claim that impulsive behaviour in specific situations may be stable over time, but the tendency to behave impulsively in general may not be. Casper (1990) in an 8-10 year outcome study with women who had recovered from the restricting type of anorexia nervosa reported that they were characterised by greater than normal reserve and self-control. This suggests that these are stable traits across time, at least in those with restricting anorexia nervosa, and they survive apparent recovery from restricting anorexia nervosa suggesting they are not state (starvation) dependent.

Over 17 years ago Milich and Kramer (1984) reported upon the lack of clear consensus among clinicians and researchers regarding the meaning of impulsivity. They commented that given the clinical significance of impulsivity, one could be forgiven for assuming that this construct has been carefully defined and operationalized, however this is not the case. This comment remains true today and may seem surprising to some, given that it is implicated in many disorders and the DSM-IV devotes a category to it, disorders of impulse control not elsewhere classified. This is further reflected in a comment made by Webster & Jackson thirteen years later (1997).

> "The construct of impulsivity, although it may be hard to define concretely, has held a place of prominence in both psychiatry and psychology for some time and has become increasingly important over the past decade" (Webster & Jackson, 1997:3).

From the literature the construct of impulsivity certainly is prominent in both psychology and psychiatric disorders. More research is obviously required to assess whether there are separate dimensions of an impulsivity construct or whether the proposed dimensions are separate constructs. Whilst it continues to be debated whether impulsivity is a state or a trait, other researchers have been trying to identify whether there is a biological basis of impulsive behaviour. In addition whether impulsivity is a stable personality trait or situation specific.

1.7. Biological Basis of Impulsivity.

Biological explanations of impulsivity have been sought and most of the research into biological factors associated with impulsivity has investigated the serotonin hypothesis. This is that low levels of the neurotransmitter serotonin or 5-HT (5-Hydroxytryptamine) are involved in impulsive behaviour. One researcher (Lucki, 1998) has commented that the role of brain serotonin in mediating impulse control is an area of major interest in biological psychiatry.

The neurobiological basis of impulsive behaviour has been investigated mainly in animals. In humans when the neurobiological basis of impulsive behaviour has been looked at, much of the research has concentrated on impulsive aggression. Lucki (1998) suggested that the main role of 5-HT in aggressive behaviour has been "its role in controlling the impulse to engage in aggressive, antisocial, or punished behaviors." (p 155). Low or lowered central nervous system (CNS) activity of the neurotransmitter 5-HT has been implicated as a factor in impulsive behaviour and impulsive aggression. Mehlman, Gugket, Faucher, Lilly, Taub, Vickers, Suomi and Linnoila (1994) proposed that individuals who have lower than average 5-HT activity are prone to trait-like impulsivity, while on the other hand those individuals with higher than average 5-HT activity are prone to the behaviours of greater rigidity and inhibition. Based on this proposal of Mehlman et al (1994) it would then be hypothesised for groups of people with disorders in which impulsivity is implicated, such as ADHD and bulimia nervosa, to have lower 5-HT activity and those with disorders where there is too much control, such as anorexia nervosa, to have higher than average 5-HT activity.

There are a variety of approaches to measuring central nervous system (CNS) 5-HT function in humans. One approach to assessing CNS 5-HT levels has been by measuring cerebrospinal fluid (CSF) concentrations of the main 5-HT metabolite 5-Hydroxyindoleactetic acid (5-HIAA). Levels of CSF 5-HIAA are thought to reflect central levels of 5-HT. Another approach to measuring CSF levels of metabolites is to measure metabolite (5-HIAA) levels following the administration of the drug probenecid. Probenecid blocks the transport of acid metabolites out of the CSF (Willner, 1985). This results in an increase in the CSF levels of the metabolite, and may be a better indicator of CSF metabolite levels, especially in those with depression. 5-HIAA or 5-HT levels can also be measured from blood platelets or urine, however these are peripheral measures. Other more indirect approaches of measuring serotonergic functioning is to use neuroendocrine measures such as plasma prolactin or cortisol levels, as these neuroendocrine responses are believed "...to be mediated by brain serotonergic mechanisms.." (Murphy, Mellow et al., 1990; p7). The effects of drugs which have selective serotonergic actions on these neuroendocrine responses are also measured, as plasma prolactin levels increase after administration of a 5-HT agonistic agent (i.e. fenfluramine) or a 5-HT precursor (5-HTP) (Murphy, Mellow et al., 1990).

Individuals with psychiatric and behavioural disorders that are characterised by impaired impulse control, including impulsive fire setters, violent criminals, excessive alcohol abuse and dependence, bulimia nervosa and parasuicide have been found to have low CSF 5-HIAA levels (Linnoila et al., 1989; Fishbein et al, 1989). CSF 5-HIAA levels however might not be a good measure of the ascending 5-HT system. In a review of 5-HT Soubrié (1986) outlines the 5-HT pathways and notes that cell bodies of the serotonin neurons are located in the midbrain raphe nuclei. Neurons of the dorsal and median nuclei give rise to the major ascending projections while neurons in the other nuclei innervate mainly the spinal cord and cerebellum. It may therefore be that CFS levels of 5-HT are a reflection of the descending pathways. Similarly Markowitz & Coccaro (1995) claim that taking CSF levels and blood platelet concentrations of 5-HIAA as a measure of central 5-HT levels is problematic as "they are peripheral to the CNS and may not truly reflect events in the brain" (p71). Whilst there are problems with using measurements of CSF 5-HIAA as an index of central 5-HT activity, results generally show a negative correlation between impulsive behaviours and CSF 5-HIAA levels. This includes suicidal behaviour (Brown, Ebert, Goyer, Jimerson, Klein, Bunney, & Goodwin, 1982) and criminal behaviour (Linnoila, Virkkunen, Scheinin, Nuutila, Rimon, & Goodwin, 1983). Linnoila et al (1983) found that violent impulsive offenders had low concentrations of CSF 5-HIAA. Interestingly this was not found in violent offenders who had premeditated their crimes. Linnoila et al (1983) suggest that low CSF 5-HIAA concentration may be a marker of impulsivity rather than violence. Brown and Linnoila (1990) also mentioned that it is impulsivity rather than violence that is the link with low CSF 5-HIAA levels, however this is not conclusive due to the difficulty in separating out aggression from impulsivity in those studies that have found low CSF 5-HIAA levels.

In a review of the relevant literature Stein et al (1993) claim that the most consistent finding in individuals who have an Impulse Control Disorder is abnormalities in serotonin transmission. They also note that a core feature of pathological gambling, which is one of the disorders of DSM-IV Impulse Control Disorders, is the inability to control the impulse to gamble.

Askenazy et al., (2000) investigated the relationship between platelet 5-HT content and impulsivity in two groups of adolescents, a patient group and a control group. The patient group consisted of adolescents who had been admitted to a psychiatric ward due to frequent impulsive behaviours, this did not include individuals who had an alcohol or substance abuse disorder, and a control group from an orthopaedic ward in the same hospital. A positive correlation was found between blood platelet 5-HT content and impulsivity as measured by the self-report IRS, in the patient group but not in the control group. As mentioned previously blood platelet serotonin concentration is a peripheral measure of serotonin activity and Askenazy et al., (2000) note that the relationship of peripheral 5-HT function to that of central 5-HT function is unclear. This is consistent with the view of Markowitz & Coccaro (1995).

Soubrié and Bizot (1990) measured impulsivity in rats where impulsivity was defined in terms of waiting capacity or in terms of ability to tolerate delayed reward. They found that drugs which enhance serotonergic transmission, such as 5-HT uptake blockers, decreased impulsivity, whilst drugs that reduced 5-HT transmission increased impulsivity. This is consistent with the hypothesis that low levels of serotonin are found in individuals who engage in impulsive behaviour. They found that generally all antidepressants drugs that they studied enhanced waiting capacity. It is hypothesised that this may explain why such drugs are beneficial in the treatment of disorders such as bulimia nervosa, and anorexia nervosa where there are problems with impulse control. However anorexics appear to be over-controlled.

Bulimic patients with anorexia were found to have reduced impulse control compared with nonbulimic patients and also had lower post probenecid CSF 5-HIAA concentrations than nonbulimic patients and controls (Kaye et al. 1984). Soubrié (1986) suggests that as serotonergic spinal innervation accounts for CSF 5-HIAA levels it may be that it is spinal and not brain serotonin transmission that is involved in the control of impulsive behaviours. If this is the case then CSF levels of 5-HT metabolites and peripheral measures of 5-HT are, after all useful indices of serotonin function in relation to impulsivity.

Drugs that enhance 5-HT functioning, such as the Selective Serotonin Reuptake Inhibitors (SSRI), have been reported to have a favourable effect on impulsive aggression in patients with Borderline Personality Disorder (Cornelius, Soloff, Perel, & Ulrich, 1991), and in individuals who have self-injured (Markowitz, 1995). However as Coscina (1997) points out, just because a drug which enhances 5-HT functioning is effective in treating a disorder, it does not necessarily mean that the disorder is due to a 5-HT deficiency, however the rationale could follow. This is problematic for postulating that a disorder is due to low 5-HT on the basis of it being treated successfully with a drug which enhances 5-HT functioning. A further problem with the 5-HT hypothesis is that the release of brain 5-HT sometimes inhibits dopamine transmission. As Montgomery & Grottick

(1999) point out transmitter systems interact with one another and do not work in isolation. Montgomery & Grottick (1999) on studies of feeding behaviour and ICSS found that the nature of interactions between dopamine and 5-HT varied with the subtype of 5-HT receptor manipulated. These findings highlight that neurotransmitter functioning is not straight forward.

Although abnormally low levels of 5-HT functioning have been linked to many disorders, involving poor impulse control, such as anorexia and bulimia nervosa (Scholberg, et al; 1989) substance abuse and gambling, Coscina (1997) suggests that as dysfunction of the 5-HT system has been linked with so many disorders that can be viewed as involving problems with impulsivity this raises two issues:

1. The specificity of the construct impulsivity, and
2. The specificity of the chemical abnormality putatively involved (in this case, low functioning of the serotonin system).

(Coscina, 1997:107).

Soubrié (1986) proposes the evidence suggests that the serotonin system is involved in behavioural inhibition or when an overt conflict arises between making or refraining from making response contingencies. This can be seen in situations where an animal is on a DRL (differential reinforcement of low responding) schedule that requires both action and inhibition, (although not at the same time) so as to create a conflict paradigm. Animal studies have found that rats make more premature responses, suggestive of impulsive behaviour, after lesions to the 5-HT ascending pathway (Wing & Wirtshafter, 1982; cited in Soubrié, 1986). However Ho, Al-Zahrani, Al-Ruwitea, Bradshaw and Szabadi (1998) note that whilst impulsiveness is a term used to describe a type of behavioural disorder, this does not imply that this definition corresponds to any single behavioural process. Neither does it imply that this clinical behaviour will be found to be the consequence of one biological mechanism: as impulsiveness is an over-complex construct whose behavioural processes are many.

1.8. A model of impulsivity.

A model of impulsivity has been proposed by Evenden (1999b). Evenden's model is based upon the same premise to that of much of modern associative conditioning, specifically that of Dickinson's (1980) account of casual relationships. Dickinson's theory is that organisms learn that event 1 leads to expectations about other events (event 2) which might or might not occur. Organisms also learn about actions or behaviours that can affect the occurrence of these events. Based on this account of Dickinson's, Evenden suggests that impulsivity can have an influence on behaviour at any one of three stages. These are the preparation stage, the execution stage and the outcome stage. Impulsive behaviour at the preparation stage results in a response being made before an individual has obtained all the necessary information. This can be seen in performance on tasks such as the Matching Familiar Figures

Test (MFFT, Kagan, 1966) where an impulsive individual would make more errors and have a shorter latency to first response due to responding before they had gathered all the information available. Impulsive behaviour at the execution stage results in behaviours seen in individuals with ADHD, such as failure to follow instructions, difficulty awaiting one's turn and interrupting others. Impulsive behaviour at the execution stage also leads to poor performance on a differential reinforcement of low responding task (DRL schedule). This involves withholding a response until a specified time has elapsed with reinforcement only being delivered following a response after this time period. For example a DRL 6-second schedule requires the withholding of a response until 6 seconds has elapsed. By responding too soon the clock resets to zero and reinforcement is lost. In the third and final stage in Evenden's (1999b) model he suggests that impulsive behaviour at this stage, the outcome stage, is important in maintaining substance abuse. Preference for an impulsive choice at this stage leads to failing to delay gratification. This also results in impairment on performance of delay of reinforcement tasks. Evenden (1999b) does not propose that the different stages of the model result in different subfactors of impulsivity which correspond to the factors derived from questionnaire measures of impulsivity, although he suggests there are similarities (p189). However it does not become clear where the risk-taking aspect of impulsivity fits in with this model or the venturesomeness factor of Eysenck et al (1985), which Evenden notes in his article "...contains items related to risk-taking and sensation seeking" (p181). Although Evenden (1999b) does acknowledge that impulsivity contains different factors, perhaps his model is too narrow and does not incorporate the questionnaire measure factors but rather is slanted towards the behaviour measurement of impulsivity.

1.9 Risk-taking: a dimension of impulsivity?

One proposed dimension or component of impulsivity is risk taking. Whilst most impulsive behaviour has an element of risk associated with it not all risk taking behaviour is impulsive. Zuckerman (1993) notes that whilst mountain climbers are sensation seekers and there is risk involved they are not impulsive. Zuckerman claims that in such situations the risk is minimised through planning and training and the experience is the reward for mountain climbers.

In a model of risk taking behaviours Cooper, Agocha & Sheldon (2001) suggested that impulsivity is expected to directly predict risky behaviours. They found that impulsivity does predict some risky behaviours such as heavy drinking and lack of condom use and suggested that at least some risky behaviours are a consequence of poor impulse control. Lane & Cherek (2000) mention that many activities involve some degree of risk and risk taking behaviour can result in negative consequences. They note that one theory of risk taking behaviour is deficient inhibition/self control.

Whilst most impulsive behaviour has an element of risk to it, not all risk taking (or risk seeking) behaviour is impulsive. This can be seen in careers where there are risks, such as police officers, firemen; and with certain recreational activities that involve risks, such as scuba diving and sky diving, but the behavior is not impulsive in nature. These behaviours are not impulsive because they are well planned so as to minimise risk. Horvarth & Zuckerman (1993) note that high sensation seekers (people who seek out activities which increase arousal) are more willing to accept risks, and suggest that "risk taking may also involve the trait of impulsivity" (p 42).

Bromiley & Curley (1992) state that risk taking may be a personality trait in itself. From a personality trait theory point of view, risk-taking behaviour would be considered to be reasonably consistent across situations. Bromiley & Curley (1992) accept that individuals differ in their attitudes toward risky behaviour, with some seeking risks whilst others avoid it. However they also suggest that risky behaviour differs not just across people but across situations. Theorists differ on whether risk taking or risk seeking, like impulsivity, is a state as opposed to a trait. There is also some disagreement as to whether it is a personality trait itself or part of other traits such as sensation seeking (Zuckerman, 1983) or impulsivity (Eysenck et al 1985; Eysenck & Eysenck, 1991;). Risk-taking behaviour whether conceptualised as a state, a separate personality trait, as being due to impulsive behaviour, being predicted by impulsive behaviour, or co-existing with impulsive behaviour appears to be linked with impulsive behaviour.

Lane & Cherek (2000) furthermore note that the term risk taking is a broad concept. Risk-taking has been defined as "any purposive activity that entails novelty or danger sufficient to create anxiety in most people" (Levenson, 1990, 1073). Whilst according to Yates and Stone (1992) the term risk taking suggests that the behaviour is deliberate. However there are common risky behaviours that are not deliberate. With deliberate behaviours the person weighs up the risks and decides how to behave, such as engaging in risky activities, sports or careers. Whereas with nondeliberative risky behaviour such as that measured by the I-7 impulsiveness scale the person does not take the risks into account. Trimpop (1994) also takes into account that risk taking behaviour can be deliberate or non-deliberate in his definition. He therefore defines risk taking behaviour in broader terms to be applicable to different domains. Risk taking behaviour is defined as:

"any consciously, or non-consciously controlled behavior with a perceived uncertainty about its outcome, and/or about its possible benefits or costs for the physical, economic or psycho-social well being of ones self or others" (Trimpop, 1994: 9).

The definition of Trimpop (1994) covers both the risk taking behaviour that may be impulsive in nature and the risky behaviour which is not impulsive in nature. Further supporting the notion that some risk taking behaviour is linked to impulsive behaviour.

Yates & Stone (1992b) suggest that risk is defined differently by different people and within different domains and that there is ambiguity about what it is. However what is not ambiguous is that the construct of risk is central to risk taking behaviour. Yates & Stone (1992b) define risk as involving potential loss and claim that it is often characterised subjectively because the risk is particular to a particular person. Furthermore they claim that "risk manifests itself in different ways in different situations". (Yates & Stone, 1992b; p2). They suggest that there are three elements to risk and risk taking behaviour. As most risk taking situations involve a choice between alternatives the first element associated with the choice behaviour is loss. Loss occurs when the outcome of the chosen alternative is less appealing than the outcome of the alternative that was not chosen. The second element is significance. The more significant the potential loss is to the person the greater the risk involved. The significance of a particular loss will vary from person to person. As they claim that risk manifests itself in different ways in different situations then this would suggest that not only would risk vary from person to person but also from situation to situation. For example person A may see no risk associated with the use of illicit substances whilst in the company of like minded people at home, however in a setting with work colleagues the significance of risk associated with such a behaviour might be greater. The third and final element to risk is uncertainty. In a risky situation there is uncertainty about the outcome. If the outcomes were guaranteed then Yates and Stone (1992b) suggest that there would be no risk.

As mentioned above risk, or risk taking behaviour, is defined differently within different domains. This is evident by comparing how risk is conceptualised by different professions. Within medicine and epidemiology risk is usually discussed in terms of the likelihood of death or contracting a particular disease (Kleinbaum, Kupper & Morgenstern, 1982, cited in Yates & Stone, 1992b). In economics it is used to refer to investments or opportunities where returns are not guaranteed (Camerer & Kureuther, 1989; cited in Yates & Stone, 1992b). Lane & Cherek (2000) claim that excessive risk taking behaviour can jeopardise a person's health and social functioning. They cite risk taking behaviours as including "frequent substance use, crime, violent crime, pathological gambling, hazardous driving or driving while intoxicated, and risky sexual practices" (p179). Furthermore they claim that these behaviours can result in consequences such as injury, job loss, incarceration, long term illness and even death. These risky behaviours which Lane & Cherek (2000) refer to are behaviours which are often also conceptualised as being impulsive in nature.

Gerbing et al (1987) identified 15 factors of impulsivity, with risk taking (thrill seeking they labelled it) being one of the main components. Gomà-i-Freixanet (1995) suggested that risk-taking behaviour could be due to impulsiveness. Gomà-i-Freixanet (1995) examined personality variables in 3 groups of males who engaged in risky behaviour and a control group. The three risk taking groups were 1) an antisocial group who consisted of male prisoners who had committed crimes such as armed robbery that involved physical risk of injury or death; 2) sportsmen engaged in risky sports and 3) men employed in risky prosocial jobs such as firemen and policemen. Results showed that the antisocial group had significantly higher impulsiveness scores (I-5) than the other three groups. Impulsiveness scores for controls, prosocial and sportsmen groups were similar to scores obtained by Eysenck and Eysenck (1978) in a sample of 402 males from a variety of different occupations including nurses, students of education and employees of a publishing company. The results thus demonstrate that impulsive behaviour has an element of risk-taking, while not all risk taking behaviour is impulsive. Horvath and Zuckerman (1993) found a low positive correlation between a self-report scale of impulsivity (I-5) and risky behaviour in four areas: crime risk, financial risk, minor violations risk and risk of injury during sport. Thus providing some support for a relationship between impulsivity and risk-taking behaviour.

McGown, Johnson and Shure (1993) suggest that the simplest explanation as to why impulsive people get into trouble is because they do not understand the risks they are taking. It thus seems apparent that the relationship between impulsivity and risk-taking needs clarification. Are people risk-takers because they are impulsive and fail to look ahead to the consequences of behaviour? The relationship between risk-taking and impulsivity will be explored throughout the studies in this thesis.

The literature in chapter two deals with impulsive or self-controlled behaviour associated with behaviours such as smoking, drug use, and with the psychiatric disorders of attention deficit hyperactivity disorder and eating disorders. It is these behaviours and clinical conditions that have been investigated in this thesis.

Chapter Two

Psychiatric conditions and non-clinical behaviours featuring impulsive aspects.

2.0 Introduction.

As noted in chapter one impulsivity either forms part of the diagnostic criteria or is a characteristic of numerous psychiatric disorders. These include personality disorders such as Borderline Personality Disorder, Antisocial Personality Disorder, and behavioural disorders of Conduct Disorder, Oppositional Defiant Disorder, and ADHD. Substance misuse includes elements of the person being unable to stop drug use even if they want to (DSM-IV,1994) and the eating disorder of anorexia nervosa is characterised by excessive self-controlled behaviour whereas bulimia nervosa involves bingeing behaviour where the eating is out of control (DSM-IV, 1994). Other behaviours such as cigarette smoking have also been linked to impulsive behaviours. All of these behaviours or disorders have a common element, that of problems with impulse regulation, be it either too much impulsive behaviour or too little which results in controlled and rigid behaviours. The literature reviewed in this chapter is specific to impulsivity in disorders and behaviours which are either characterised by impulsive behaviour or where impulsivity forms part of the diagnostic criteria. The material covered reflects the populations chosen to investigate impulsivity in the current research.

2.1 Smoking and impulsivity.

Research has indicated that smokers are more impulsive than non-smokers. Mitchell (1999) found regular non abstinent smokers scored higher on 26 out of 28 self-report scales of impulsivity than non-smokers and had shorter response times on three behavioural tasks. Smokers also had steeper discounting of delayed monetary rewards, that is they showed more preference for the smaller immediate reinforcer over a larger delayed reinforcer than non-smokers on an operant choice task (Mitchell, 1999). Pritchard, Robinson and Guy (1992) reported that smokers had significantly faster reaction times on a continuous performance task during a smoking session compared with a non-smoking session. There was however no effect of smoking on errors of commission (responding to non-target stimuli) or omission (failing to respond to the target), thus demonstrating that faster reaction times during the smoking session were not due to speed accuracy trade off, and that smoking can induce impulsive behaviour as measured by rapid responding. However as nicotine is a psychomotor stimulant (Julien, 1992) faster reaction times in the Pritchard et al (1992) study could be attributed to the psychostimulant effects of nicotine.

Warburton and Arnall (1994) deprived smokers for 10 hours and reported no difference between deprived smokers and non-smokers in correct detection (hits), commission errors or reaction time on a continuous performance task. Warburton and Arnall did find that the number of correct detections increased and reaction time decreased in smokers who were deprived for 1 hour or 12 hours and then smoked during the task compared to those who sham smoked. They found no effect of deprivation period and claim therefore that the results cannot be due to relief from withdrawal. These results suggest that the effects of smoking may be state dependent.

Morgan (unpublished, personal communication) distinguished between state and trait impulsivity and found that non-abstinent smokers had higher state impulsivity scores (as measured by a version of the MFFT) than non-smokers, in that they made more errors and had faster latency to first response. The abstinent smokers did not differ from either group on MFFT impulsivity. However on trait impulsivity the non-abstinent smokers did not differ from the non-smokers. On trait impulsivity as measured by the I-7 it was the abstinent smokers who had the higher impulsiveness scores, whereas the non-abstinent smokers had the lowest impulsiveness scores. Morgan reports that the results suggest higher impulsivity in smokers is state dependent and may be due to the pharmacological effects of smoking. Mitchell (1999) claims that whether the differences in impulsivity between smokers and non-smokers seen in her study are due to state or trait does not make them any less interesting. As Mitchell (1999) points out smokers can be considered to be impulsive by the nature of the event they engage in, that they prefer short term immediate reinforcing effects of smoking cigarettes over the longer term benefits of abstinence: a healthier and wealthier life. Cigarette smoking has been reported as being higher in adolescents and adults with attention deficit hyperactivity disorder, (ADHD), compared with the general population (Barkley, Fischer, Edelbrock & Smallish,1990; Milberger, Biederman, Faraone, Chen & Jones,1997) and may reflect impulsivity and risk-taking behaviour or it may be a form of self medication.

2.2. Impulsivity and ADHD.

ADHD: What is it?

It has been claimed that research into impulsivity in children has been greater than with any other population (McGown, Johnson & Shure, 1993). McGown et al. (1993) suggest that this is due to the prevalence of Attention Deficit Hyperactivity Disorder (ADHD). Impulsivity is one of the three main symptoms of ADHD which is a disorder diagnosed according to DSM-IV (APA,1994) criteria and is characterised by developmentally inappropriate inattention and/or hyperactivity and impulsivity. Impulsivity is also an associated feature of the International Classification of Diseases (ICD-10, WHO, 1993) Hyperkinetic Disorder. Davidson & Neale (1994) classify Attention Deficit Hyperactivity Disorder as a disorder of undercontrolled behaviour in relation to age, meaning that the child lacks or has insufficient control over their behaviour relative to their peers in a particular situation (Davidson & Neale, 1994). The literature reviewed in this section indicates that those with ADHD engage in behaviours that can be classified as impulsive, and exhibit more impulsive behaviour than their peers.

ADHD and impulsivity.

Halperin, Newcorn et al. (1995) point out that the DSM-IV (APA, 1994) defines impulsivity according to the presence of behaviours such as blurting out answers, difficulty waiting one's turn and interrupting or intruding upon other. Whilst Taylor (1998) points out that in both ICD-10 and DSM-IV impulsiveness is operationalised in terms of rapid responsiveness, Halperin et al. (1995) claim that "these examples do not provide an operational definition that can clearly differentiate impulsivity from other presumably distinct constructs" (p 1200). Taylor (1988) suggested that independently of ADHD, impulsivity is associated with defiance and it is the impulsivity which accounts for the comorbidity between ADHD and other disruptive behavioural disorders. As noted before, impulsivity is not only a symptom of ADHD but also of conduct disorder and other DSM-IV disorders including drug abuse and misuse. A follow up study of ADHD children into adolescence, reported that 41% of the childhood ADHD group's (DSM-III-R) parents indicated the presence of impulsivity symptoms in their child compared with 16% of the controls parents (Manuzza, Klein, Bessler, Malloy & LaPadula,1993).

Barkley (1990) stated that it remains unclear which aspects of impulsivity are problematic for ADHD, and that these children often respond too quickly to situations. They also often fail to consider potentially negative, destructive or even dangerous consequences, and engage in frequent, unnecessary risk taking. Consequently accidental poisonings and injuries are not uncommon. Cooper and Indeus (1996) claimed that "children with

ADHD are not as responsive to rewards and consequences as other children" (p.18). This is consistent with impulsive behaviour where individuals fail to look ahead to the consequences of their behaviour and discount delayed rewards. Douglas (1980) suggested that children with ADHD have an unusually heightened response to immediate reinforcement, which again is reflected in them choosing smaller immediate reinforcers in an operant choice paradigm over larger later reinforcers. On the other hand Wender (1974) claimed that individuals with ADHD have a diminished response to both positive and negative reinforcement. Haenlein & Caul (1987) suggest that there may be an elevated reward threshold which has the effect of decreasing the magnitude of the reward which is experienced by a child with ADHD. This can also be seen in delay of gratification tasks where children with ADHD discount delayed rewards (Schweitzer & Sulzer-Azaroff, 1988; Sonuga-Barke et al., 1989).

Sonuga-Barke & Taylor (1992) using a computerised version of the MFFT found that hyperactives (for a distinction between hyperactive and ADHD refer to chapter 6) made more errors and had significantly shorter response latencies than controls. These results are classified as impulsive behaviour. However, when they imposed a trial length of 45 seconds for incorrect responses the hyperactive group had a tendency for longer response times, although it was not significantly different from the controls. Sonuga-Barke uses these results to support his hypothesis that hyperactive children are delay averse and are able to withhold a response, depending upon the situation. Sonuga-Barke claims that hyperactive children's faster response latencies in the standard MFFT may not reflect impulsiveness but rather is an attempt to reduce the session length. However the imposition of a 45 second trial length only for incorrect responses could be viewed as a punishment contingency and Sonuga-Barke and Taylor (1992) do acknowledge this.

<u>Discrete trials operant choice or delayed reinforcement in ADHD.</u>

Sonuga-Barke, Taylor, Sembi & Smith (1992) using an operant choice paradigm found that 6-7 year old children with and without hyperactivity both chose the smaller immediate reward, 1 point delivered after 2 seconds versus 2 points delivered after 30 seconds when there was no post reinforcement delay associated with either choice. In this instance choosing the smaller immediate reinforcement yielded the higher reinforcement density and therefore was the adaptive choice. Rewards used were points earned which were exchanged for 20 pence after the experiment. When a post reinforcement delay (post delay condition) was added to both choices, 30 seconds to the small immediate choice and 2 seconds to the larger delayed, which made overall delay per trial equal between the two choices, then both the hyperactive group and the control group showed a preference for the larger delayed reinforcement which was associated with greater reinforcement density (2 points delivered after 30 seconds vs 1 point after 2 seconds). The hyperactive group had a tendency to choose the larger delayed reinforcement more than the controls although it was not significantly different. Sonuga-Barke et al

(1992) claim that whilst the results in the post delay condition suggest that both groups are reward maximizers this may not be the case for the hyperactive group. They argue that in the post delay condition hyperactive children may be sensitive to post reinforcement delay and this is why they chose the larger delayed choice as it was associated with less post reinforcement delay. Thus Sonuga-Barke et al. (1992) are suggesting that hyperactive children are delay averse rather than exhibiting discounting of delayed rewards, which is what impulsive people do.

Sonuga-Barke et al. (1992) tested the hypothesis that hyperactive children are sensitive to post reinforcement delay. As in their previous study (outlined above) they had no post reinforcement delay associated with either choice, but added a time constraint in which participants had 10 minutes to make as many choices as they wished to earn points. Following this there was a trials constraint in which participants only had 20 choice trials to make. In both conditions each point earned was exchanged for a penny. Therefore the more points earned the more money earned. In the time constraint condition the highest reinforcement density was again associated with the smaller more immediate reinforcement whereas in the trials constraint the highest reinforcement density was associated with the larger delayed reinforcer. In the time constraint both groups showed a preference for the smaller immediate reinforcer which was associated with more overall reinforcement. However with the trials constraint the hyperactive group's preference was again for the smaller immediate reinforcer (1 point after 2 seconds) whereas the control group's preference shifted to the larger delayed reinforcer (2 points after 30 seconds). Under the trials constraint the controls earned significantly more reinforcement than the hyperactive group. Sonuga-Barke et al (1992) explain that their results support the hypothesis that hyperactive children are delay averse rather than reward maximisers.

Sonuga-Barke et al. (1992) do acknowledge that hyperactive children may have waited if they were responding for consumable reinforcers such as sweets or access to a video games rather than for secondary reinforcers. The results from the trials constraint task is not in line with previous research where researchers have found it difficult to demonstrate impulsive responding when using points exchangeable for money. Logue et al. (1990) reported that adult humans responding for points exchangeable for money showed consistent self-control when this resulted in subjects receiving more total reinforcement than they would have for the impulsive choice. Studies using conditioned reinforcers such as points exchangeable for money have only produced impulsivity when the impulsive choice has resulted in greater reinforcement density (Flora & Pavlik, 1992). The discrepancy in the results between Sonuga-Barke et al. (1992) and those of Logue et al, (1990) and Flora & Pavlik (1992) may be due to age, in that Sonuga-Barke et al. used children and the other two studies used adults, or it may be an effect of the ADHD (hyperactivity).

Sonuga-Barke, Saxton & Hall (1998) again used an operant choice paradigm and reported that children with ADHD are able to tolerate delay but they are delay minimisers or delay averse in that they aim to minimise delay rather that maximise reward. Sonuga-Barke et al (1992) claimed that the general assumption is that children don't wait because they are unable to. In contrast Sonuga-Barke et al. suggest it may be because they do not want to wait and suggest that it is a problem with delay aversion rather than a deficit in impulse control.

Also using a choice task Schweitzer & Sulzer-Azaroff (1995) kept trial length between the small immediate reinforcer and the larger delayed reinforcer equal (as did Sonuga-Barke et al, 1992) by imposing a post reinforcement delay onto the smaller immediate reinforcer which was equal to the pre-reinforcer delay of the larger delayed choice. Therefore trial length and session length were equal regardless of the choice made. They found that controls chose the delayed reinforcer more than 6 year old ADHD children and the controls preference for the larger delayed reinforcer increased from one session to another whilst the ADHD children's choice of the larger delayed reinforcer decreased across sessions. In this situation the greater reinforcement density was associated with the larger delayed choice and whilst trial and session length were kept equal reinforcement densities were not equal between the two choices. Schweitzer (1996) suggests that their results could be due to ADHD children being less sensitive or indifferent to the size of reward. The results of Schweitzer & Sulzer-Azaroff (1995) do not support Sonuga-Barke et al. (1992) suggestion that hyperactive children are sensitive to post reinforcement delay, as in their study the smaller immediate reinforcer was associated with more post reinforcement delay than the larger later reinforcer. What it seems to suggest is that ADHD children are unable to tolerate pre-reinforcement delays and they are unable to delay gratification or reinforcement, that is they demonstrate impulsive behaviour.

Rapport, Tucker, DuPaul, Merlo & Stoner (1986) used a variant of Mischel's 1974 delay of gratification paradigm, with hyperactive children and controls. In the Mischel delay of gratification paradigm children either signal for the experimenter to return to a room and receive a less preferred snack or toy (smaller more immediate), or wait for the experimenter to return without signalling and receive the more preferred snack or toy (larger later reinforcer). Rapport et al found that 94% of the hyperactive children chose the immediate smaller reward. Of the controls 69% chose the delayed reward compared with only 6% of the hyperactive children. However when both the small and large rewards were immediate then all children in both groups selected the route to obtain the larger reward. Rapport et al (1986) suggest that instead of attempting to maximise each reinforcing event, the hyperactive child obtains the minimum reward and then moves to alternative situations. They called this "the grab and run experience" (p201).

DRL: using an immediately consumable reinforcer.

A number of studies have tested impulsive responding of children with ADHD by their performance on a DRL (differential reinforcement of low rates of responding) schedule. This requires the withholding of a response until a set time period has elapsed, in order to obtain reinforcement. In order to obtain maximum reinforcement a person needs to respond at a low rate, and withhold a response until the allocated time since the last response has elapsed. Those who respond at a high rate are classified as impulsive responders, as they cannot withhold a response. Children who had been rated as hyperactive by their teacher made more responses on a DRL 6 second schedule and received less reinforcement, which were M & M chocolates (Gordon, 1979). Gordon claims that the results demonstrate that hyperactive children are significantly more impulsive than non-hyperactive children as measured by the DRL schedule.

Inhibitory control.

Schachar, Tannock & Logan (1993) have investigated inhibitory control in the stopping of an ongoing response. They used the stop signal paradigm. In this a participant is taking part in a primary task such as a forced choice reaction time task where they are to respond as quickly and accurately as possible. On some trials (unpredictably) a stop signal is presented (usually a tone) which is the instruction to withhold responding on the primary task. Schachar et al. measure whether the response is withheld. They reported that on average children with ADHD had stop signal reaction times 100ms longer than either controls, children with conduct disorder (CD) and ADHD children with comorbid CD. The ADHD group also had significantly flatter inhibition slopes than controls. These results suggests that children with ADHD have difficulty in stopping an ongoing response and withholding a response.

Factor analytic studies of impulsivity in children with ADHD have failed to generate an impulsivity factor which is separate from inattention or hyperactivity (DuPaul, 1991). Despite this, research has found ADHD children and adolescents to be more impulsive than controls, however many studies have failed to find a difference in impulsivity between children with ADHD and those with other psychiatric disorders. Halperin et al. (1992) reported that tests of impulsivity such as the MFFT and the Porteus Maze test have been found to distinguish ADHD patients and non-ADHD patients from controls. What is problematic is the ability of these tests to distinguish between individuals with ADHD and other patient groups. This is however not surprising given that many studies use individuals with conduct disorder as the non-ADHD patients and ADHD is often comorbid with conduct disorder. Furthermore impulsivity is a symptom of many other disorders as diagnosed by DSM-IV including conduct disorder.

ADHD and smoking.

Barkley, et al. (1990) reported that as children with ADHD reach adolescence they are significantly more likely to smoke cigarettes than controls. Milberger et al. (1997) suggest one reason why there is a higher prevalence of smoking amongst adolescents with ADHD relates to the "nicotinic receptor hypothesis". The theory behind this is that as nicotinic receptors modulate dopaminergic activity and dopaminergic dysregulation has been hypothesised to underlie ADHD, consequently the nicotine may be having a stimulant effect and thus be a form of self-medication. In addition to promoting the release of dopamine, nicotine also promotes the release of the neuotransmitters noradrenaline and serotonin (5-HT). Milberger et al. (1997) in a 4 year follow up study of individuals with ADHD and without ADHD (aged 9-22 at follow up) found that 19% of their ADHD group were smokers compared with 1% of the non-ADHD group. Also the ADHD group had an earlier age at onset of smoking than non-ADHD controls (15.5 years Vs 17.4 years). This difference remained significant after controlling for IQ, socio-economic status and conduct disorder

In an adult population of individuals with ADHD Levin et al. (1996) reported that approximately 40% of adults with ADHD smoked cigarettes. This compares with 26% of the general population (Garland, 1998). Levin et al. (1996) administered nicotine via a skin patch to both smokers and non-smokers with ADHD. They found that nicotine significantly improved the symptoms of ADHD in both groups and these effects were more pronounced in the non-smokers than in smokers who had been abstinent for 12 hours. Levin et al. (1996) note that as there were similar improvements seen in both smokers and non-smokers then this suggests that the effects seen were not due to withdrawal in the smoking group, but rather nicotine was having some therapeutic effect. In addition to the prevalence of smoking being higher in those with ADHD compared with their peers, higher rates of drug use have also been reported in individuals with ADHD.

ADHD and illegal drug use.

Levin, Evans, & Kleber (1998) found that 52% (of 27) adults receiving treatment for ADHD symptoms were found to have substance abuse/dependence. This rate of 52% is higher than the US expected general population rates which are given as 17-25%. Of the 27 adults 74% reported that cocaine aggravated their ADHD symptoms whilst the other 26% reported an improvement in symptoms. Weiss et al. (1988) however found that cocaine abusers who had residual ADHD all reported that cocaine use initially improved attention and impulsiveness. Horner & Scheibe (1997) reported that adolescents with ADHD, who were in treatment for substance abuse, began drug use at an earlier age and had more severe substance abuse than non ADHD substance abusers. They have also suggested that drug use may be a form of self-medication, as more ADHD substance abusers than non-ADHD substance abusers (controls) attributed their current drug use to an attempt to alter their mood (67% vs 40%). In contrast 47% of controls and only 20% of the ADHD group reported using drugs to get high. Wilens (personal communication, 1998) similarly claims that unlike controls, adolescents and adults with ADHD do not report using substances such as cocaine to get high. Horner & Scheibe (1997) suggest that based on the dopamine hypothesis of ADHD, in the initial stages individuals with ADHD may use drugs as they are rewarding.

Biederman et al. (1995) found that ADHD (DSM-II-R criteria) significantly increased the risk of substance disorders, and this was independent of any comorbidity. Adults who had childhood onset ADHD had significantly higher lifetime prevalence of drug or alcohol abuse or dependence than control adults. Furthermore alcohol misuse was more prevalent than drug misuse in the ADHD group. Like ADHD, drug and alcohol abuse/dependence can be characterised as entailing loss of control or impulsive behaviour, so the co-occurrence of these disorders is unlikely to be just coincidence, however it may be a form of self-medication as has been suggested.

Manuzza et al. (1993) in a longitudinal study followed up children aged 6-12 years with ADHD and controls. The first follow up at late adolescence, aged 16-23 years, found that 16% of the ADHD cohort had a non-alcohol substance use disorder compared with 3% of controls. Follow up again at adulthood, aged 23-30 (mean age 26 years) found 16% of the ADHD cohort had non-alcohol substance use disorders compared with 4% of controls. At adulthood, for both groups, marijuana and cocaine were the most frequently abused drugs. Although it may be that substance use is a form of self-medication for those with ADHD, it might equally be another manifestation of impulsive behaviour that they cannot control.

Wilens et al. (1997) reported that 52% of adults with ADHD had a lifetime history of psychoactive substance use disorders (PSUD) compared with 27% of controls. Furthermore they found that it was the presence of conduct disorder in both the ADHD group and controls that was associated with early adolescent onset of PSUD. The conduct disorder preceded the PSUD and was the strongest predictor of PSUD whereas ADHD was a risk factor for late adolescence to early adulthood onset of PSUD. This demonstrates that ADHD can be a factor in substance use, independently of conduct disorder.

Generally those individuals in whom ADHD persists into adolescence have been found to have a poorer outcome and more drug abuse which begins at a younger age than their peers (Horner & Scheibe, 1997). Adults who had been diagnosed with ADHD as children were found to have had over 2 years less schooling than controls (Mannuzza et al., 1997). They have also been found to have had more convictions for traffic offences at 18 years of age (Nada-Raja et al., 1997) and adolescents with ADHD were reported to have had more car accidents than their peers and to be at fault for more car accidents (Barkley, Guevremont, Anastopoulos, De Paul & Shelton, 1993). This evidence seems to suggest that in ADHD there is a generalised cross situational problem with impulse control.

Aetiological factors in ADHD.

Various theories of the aetiology of ADHD have been postulated, which include a wide range of neurological, neuroanatomical and neurotransmitter theories. Kewley (1998) claims that ADHD is a brain dysfunction and that poor parenting can exacerbate but not cause ADHD. This is a view shared by Goldstein (1998a).

Barkley's view.

Barkley (1990) conceptualised ADHD as a deficit in the regulation of behaviour by its consequences. It was "...hypothesised that ADHD arises out of an insensitivity to consequences, reinforcement, punishment or both" (Barkley, 1990, p27). Barkley suggested that in these individuals there may be a greater need for arousal, or an underactivity in the inhibitory system or these individuals may just have a higher threshold for reinforcement. Barkley (1997) considered behavioral inhibition to be the central deficiency in his theory of ADHD. He suggested that the deficit in response inhibition leads to impairments in four neuropsychological abilities that are partially dependent on inhibition for their effective execution. According to Barkley (1997) the deficit in behavioural inhibition which characterises ADHD "...diminishes the effective deployment of the four executive abilities that subserve self-control and goal-directed behaviour" (p75). Behaviour therefore becomes controlled more by the immediate context and consequences than is the behaviour of others. In a review article Pennington & Ozonoff (1996) conclude that executive function deficits are consistently found in ADHD. Along with the three symptoms of inattention, hyperactivity and impulsivity Barkley (1990) has proposed that children with ADHD also have a fourth distinguishing characteristic, that of a deficit in rule governed behaviour. He suggests that laboratory tasks which measure impulsivity may be confounded with deficits in rule governed behaviour. Skinner (1969) described rules as stimuli constructed by the social community or the individual which specify relations (contingencies) among antecedents, behaviour and consequences. Barkley's (1990) view of deficits in rule governed behaviour which arise out of impaired responses to behavioural consequences, is consistent with Skinner's view.

Brain structures implicated in ADHD.

Barkley (1990) suggested that ADHD may be a biologically based deficiency in sensitivity to reinforcement, although the biological basis is not outlined. Neuroanatomical differences have been reported between children with ADHD and age matched non-ADHD individuals. This is an area which is marked with inconsistencies. Structures within the basal ganglia of the brain have been examined with MRI . A smaller volume of the right caudate nucleus was found in ADHD children (mean age 12 years) compared to control non-ADHD children (Castellanos et al. (1998). However Hynd et al. (1993) reported a smaller left caudate nucleus in ADHD children (mean age 12) compared with control participants. A variety of brain regions have been postulated as being involved in ADHD and the findings are contradictory and non-consistent. Zametkin et al. (1990) used a PET scan to measure cerebral glucose metabolism during an attention task. They reported that adults who had childhood onset ADHD have reduced cerebral glucose metabolism compared with controls, this demonstrates that their brains are not as active as the controls during an attention task.

Other studies have found that, compared with controls, children with ADHD have a poorer performance on neuropsychological tasks that tap frontal lobe functions (Seidman, Biederman, Faraone, et al., 1997) and the frontal lobes are considered to be involved with behavioural inhibition (Luria, 1973). Support for this comes from individuals with frontal lobe brain damage who appear to become uninhibited, and behave impulsively and without control (Luria, 1973).

Neurotransmitter theories of ADHD.

Many individuals who are diagnosed with ADHD, including children, adolescents and adults, are treated with the psychostimulant medication methylphenidate, commonly known as Ritalin®. Psychostimulants are dopaminergic agonists, which enhance brain dopaminergic activity. Ritalin® has pharmacological properties similar to amphetamine (Kruk & Pycock, 1979). Many of those treated with psychostimulant medication show responsiveness to the drug, this is seen in a reduction in activity and impulsivity, and in some cases an increase in attention. These improvements seen in individuals with ADHD who take psychostimulant medication have been taken as support for the role of dopamine in the aetiology of ADHD (Garland, 1998). Further support for the role of impaired dopaminergic functioning in ADHD derives from a study where methylphenidate led to improvements on a continuous performance test (CPT); these improvements were then blocked by a dopaminergic antagonist, haloperidol (Levy & Hobbes, 1996). The findings that psychostimulants are effective in reducing the inattention, hyperactivity and impulsivity have led to the circular argument that as psychostimulants have their effect on the dopamine system therefore it must be a deficit in dopamine which underlies the aetiology of ADHD. However the mechanisms of neurotransmitters and neural pathways are not that well understood and drugs rarely have their effect on only one system.

Cantwell (1996) in a review of research into ADHD since 1986 points out that most studies investigating neurotransmitters in ADHD suggest low turnover of the catecholamines dopamine and noradrenaline. However there is an interaction between the 5-HT system and that of the cathecholamines (Cantwell, 1996). As Gainetdinov, Wetsel, Jones, Levin, Jaber & Caron (1999) point out, extracellular levels of dopamine, noradrenaline and serotonin can all be elevated by psychostimulant therapy. Also like the dopamine hypothesis of schizophrenia, the dopamine hypothesis of ADHD falls down with those individuals who remain unresponsive to the drug, and are successfully treated with other drugs such as antidepressants (Pliszka et al., 1996). Evidence for a dysfunction of the noradrenergic system in ADHD has been suggested, due to the efficacy of tricyclic antidepressants, whose presumed site of action is noradrenergic (Pliszka et al., 1996).

Animal research has led to the suggestion that the serotonin neurotransmitter system also plays a role in ADHD. Mice which lack the gene encoding the plasma membrane dopamine transporter (DAT) showed hyperactivity. This hyperactivity was exacerbated in a novel environment and the mice were impaired on a spatial function task. (Gainetdinov et al., 1999). Gainetdinov et al. (1999) note that the results suggest that DAT deficient mice might also have more difficulty in suppressing inappropriate responses. The DAT is needed to control the concentrations of dopamine by removing the neurotransmitter from the extracellular space and localising it in the cytoplasm. Using DAT knockout mice Gainetdinov et al. (1999) found that substances such as fluoxetine, which increased serotonin (5-HT) transmission, reduced hyperactivity. This reduction in hyperactivity was also seen with serotonin precursors such as 5-Hydroxytryptophan and L-tryptophan. Similar results were not seen in control mice. Interestingly hyperactivity was still reduced by psychostimulants even though the mice lacked the target on which Ritalin® is thought to have its effect. These results suggest that 5-HT function may also play a role in the aetiology of ADHD.

ADHD and long term prognosis.

For some who continue to have a diagnosis into adulthood, dysfunction is characterised by antisocial personality disorder and substance use disorders, and these are in turn, associated with criminality. These behaviours are also associated with impulsivity. Satterfield et al. (1982) reported that hyperactive children were 4-5 times more likely to have been arrested than controls. However Hetchman et al. (1984) reported no significant differences in self-reported crime. Some researchers have argued that it is the comorbidity of conduct disorder that is the factor which predicts a poorer outcome in adolescents and adults with ADHD. However

Wilens et al. (1997) demonstrated that at least for substance use, ADHD was a predictor independently of conduct disorder.

Recently Goldstein (1998b) reported in agreement with the above literature that "Children with ADHD are at risk for school failure, emotional failure, emotional difficulties and significant negative adult outcome in comparison to their peers" (p.52). Goldstein (1998b) points out that with early identification and treatment children with ADHD can have a better prognosis.

If the nature of impulsivity could be understand better in those with ADHD then treatment could be directed at management of those impulsive behaviours in conjunction with medication therapy. As discussed in chapter 6 the diagnostic criteria for impulsivity are limited and open to interpretation. The use of a variety of measures which are believed to capture different aspects of impulsivity might identify aspects of impulsivity which are present in those individuals with ADHD and establish whether they are different on these measures from age matched peers.

The aims of this aspect of the research are to assess impulsivity in adolescents with ADHD and age matched controls using the self-report questionnaire (the I-6) and the behavioural measures of impulsivity outlined in chapter 3. Based on the literature outlined in this section, and in chapter six, the ADHD group would be expected to discount delayed rewards and display preference for a smaller immediate reinforcer, to show both inattention and impulsivity on the continuous performance test, to be more risk taking and impulsive.

2.3. Problems with impulse regulation in anorexia and bulimia nervosa.

The eating disorders of anorexia nervosa and bulimia nervosa are psychiatric disorders diagnosed according to the criteria of either DSM-IV or ICD-10 (outlined in chapter 7). Both disorders are complex and multifaceted and like many disorders and behaviours they have been attributed to a wide variety of causes, from biological to social factors. One characteristic of these eating disorders is problems with impulse control: bulimia nervosa is associated with eating episodes where large quantities of food are eaten in one sitting, which are out of control (DSM-IV, APA, 1994), and can be considered impulsive. Bulimia nervosa has also been associated with other behaviours which are impulsive in nature (Lacey & Evans, 1996). Individuals with anorexia nervosa can be considered to be at the other end of continuum and display excessive self-control (Casper, Hedeker and McClough,1992)

Sohlberg (1991) reports that by definition, the disorders anorexia and bulimia nervosa would involve abnormalities of impulse control. As bulimia is characterised by eating large amounts of food where there is a sense of being out of control and this dyscontrol is the hallmark of the disorder. Anorexics, despite the term, are actually intensely hungry unless the disorder is chronic whereby feelings of hunger disappear. To maintain a very restricted food intake in the presence of intense hunger requires an immense amount of control. Sohlberg (1991) suggests that perhaps both the anorexic and bulimic individuals are hypercontrolled, however in the case of the bulimic this hypercontrol is "too brittle to remain in force indefinitely" (p 196). As we see bulimia is characterised by frequent breaches of dietary restraint.

Vitousek and Manke (1994) described bulimia nervosa as involving some behaviours which are opposite to those of anorexia nervosa and attributable to opposite traits. They described the behaviours of anorexics as being characterised by rigidity and constraint whereas those of bulimics are characterised by compulsiveness, impulsivity, and affective instability. They suggested that bulimics have an "...erratic consummatory pattern in which restraint and disinhibition alternate" (p137).

Lowe & Eldredge (1993) suggest that impulsivity may be both a causal factor and a description of eating behaviour in both normal and disordered eating. They suggest that impulsivity may cause some individuals to eat more frequently and/or to consume more food when they do eat. As a description of eating behaviour, impulsivity is used to describe eating behaviour that occurs on the spur of the moment without any forethought.

Lacey & Evans (1996) proposed, that at least for a proportion of women with bulimia, it is considered appropriate to conceptualise the disorder as a failure of impulse control. They suggested that this conceptualisation was appropriate as this subgroup has a different course of illness, and termed his multi-impulsive bulimia. Lacey & Evans conceptualise multi-impulsive bulimia on the basis of the number of impulsive behaviours that the person with bulimia engages in. These behaviours include alcohol abuse, drug abuse, multiple overdoses, repeated self-damage, sexual disinhibition and shoplifting. For a diagnosis of multi-impulsive personality disorder, each behaviour needs to be associated with a sense of being out of control and the behaviour being impulsive. Mitchell, Hatsukami, Eckert & Pye (1985) reported that 34.4% of the 275 bulimic outpatients in their study reported a history of alcohol or drug use problems. Wolfe, Jimerson & Levine (1994) note that descriptions of binge eating episodes in clinical patients with bulimia nervosa are often described as being unplanned and impulsive. Furthermore studies have reported an increased incidence of behaviours, by bulimic patients, that are deemed to be impulsive in nature such as stealing, suicide attempts and self injury (Sohlberg, Norring, Holmgren & Rosmark, 1989).

Bushnell, Wells and Oakley-Browne (1996) report that the literature on impulsivity in disordered eating has failed to explore the relationship between impulsivity and other disorders that have rates of comorbidity. This is problematic when impulsivity, like in multi-impulsive personality, is defined by the presence of a behaviour that is an integral part of another disorder. To overcome this problem Bushnell et al. (1996) excluded impulsive behaviours that define aspects of other disorders such as binge eating, drug use or suicidal behaviour and then assessed the number of impulsive behaviours exhibited by women in a community sample. They found that 11% (N = 140) of women with bulimia symptoms experienced difficulties with impulsivity. They also reported more problems with impulsivity amongst those with comorbid disorders than amongst the women with only one of either substance abuse, affective disorder, or bulimia symptoms. These findings suggest that those with more impulsive behaviours are likely to exhibit it in multiple ways.

Welch & Fairburn (1996) using a community sample recruited through GP practices, obtained a bulimic group and two control groups, a normal control and a psychiatric control. Current alcohol consumption did not differ between the bulimic group and either of the control groups. However the bulimia nervosa group did have higher rates of deliberate self harm than the other two groups. Welch & Fairburn (1996) conclude that their study does not support a multi-impulsive bulimia personality but rather "that deliberate self-harm, alcohol misuse and drug misuse may each have different relationships with bulimia nervosa rather than reflect a common disorder of impulse control" (457). This could further indicate that different aspects of impulsivity are present in different disorders and that the manifestation of impulsivity is different for different people.

Verkes, Hanno, Meinders and Van Kempen (1996) noted that patients with bulimia nervosa resemble those who have repeated suicide attempts in terms of impulsive self-damaging behaviour. This is further underlined by an earlier study (Lacey, 1993) which revealed that a high number of bulimic patients have a history of suicidal behaviour. In a more recent study of Japanese women with bulimia nervosa prevalence rates of suicide attempt was 47% (20/43) and for self-mutilation 33% (14/43) (Nagata, Kawarada, Kiriike & Iketane, 2000). Taken together these studies provide support for Lacey & Evans (1996) multi-impulsive hypothesis and indicate that some of those with bulimia nervosa are also likely to exhibit problems with impulse regulation beyond uncontrolled eating.

Disordered eating and personality measures.

Fahy & Eisler (1993) used the I-7 questionnaire to assess impulsivity in a clinical population of individuals with eating disorders. There were three groups who met DSM-III-R diagnostic criteria for either anorexia nervosa, bulimia nervosa or bulimia nervosa with a history of anorexia. They reported that the bulimics scored significantly higher on both the impulsivity scales, (impulsiveness and venturesomeness) than the anorexics. Although the bulimics with a history of anorexia did not differ significantly from either of the other groups, their scores were between those of the anorexics and the bulimics, as hypothesised. They did not find that those who engaged in two or more impulsive behaviours (the multi-impulsive group) differed in prognosis at one year follow up or had higher scores on the impulsivity questionnaire. There were however only 3 in the multi-impulsive group and one of the three did have higher scores on the IVE, which amounts to 33% of the multi-impulsive group. Whilst the results may not be conclusive support either for or against Lacey & Evans (1986) multi-impulsive personality disorder, the results do support the proposal that those with bulimia nervosa have higher levels of impulsivity than anorexics.

The proposal that bulimics have a generalised problem with impulse regulation was addressed by Wolfe et al. (1994). The Barratt Impulsivity Scale, Version 10 (BIS-10, Barratt, 1985) was used to investigate group differences in impulsivity between outpatients with bulimia nervosa and a control group. The BIS-10 contains 3 scales of impulsivity: cognitive, motor and nonplanning. The bulimic patients had significantly higher scores than the controls on all three scales, thus demonstrating higher levels of self-reported impulsivity than non-bulimic controls. The BIS-10 scores however were not significantly correlated with symptom severity as measured by the Eating Attitudes Test, 26 item version (Garner et al., 1982). This suggests that higher levels of self-reported impulsivity are not associated with severity of disordered eating. Although more problems with impulsive behaviour are associated with greater psychiatric comorbidity (Bushnell et al.; 1996).

Waller, Sheinberg et al. (1996) reported that women diagnosed with bulimia nervosa had significantly higher levels of self-reported impulsiveness than controls but the two groups did not differ significantly on venturesomeness, as measured by the I-5. The bulimics, when compared with controls, also had significantly higher scores on the BIS-11 cognitive and motor scales and the total scale.

Casper, Hedeker and McClough (1992) assessed personality dimensions in female patients hospitalised for either anorexia or bulimia nervosa. Restricting anorexics scored significantly lower on Minnesota Multiphasic Personality Inventory (MMPI) dimensions of impulsivity and danger seeking and had significantly higher scores on traditionalism than bulimia nervosa patients or controls. Casper et al. suggest that this reflects accentuated self-control, caution and conscientiousness in restricting anxorexics. Scores on the impulsivity subscale of the MMPI for the bulimia nervosa patients did not differ significantly from controls and did not exceed normal values for bulimia nervosa patients but the scores did fall in the high end of the normal range. Restricting anorexia patients scored significantly lower than either controls or the bulimia nervosa patients on the novelty seeking scale, suggesting that they are less adventurous. All three groups of patients with eating disorders scored significantly higher than controls on harm avoidance. Casper et al. concluded that anorexia nervosa patients differ from controls on personality dimensions that reflect impulsivity (behavioural control) danger seeking and cognitive control.

A study by Woznica (1990) was claimed by the author to be the first empirical study that assessed differences on a comprehensive measure of impulsivity between the subgroups of anorexia, i.e restricters vs bingers. Woznica suggests that whilst impulsive behaviour reflects an impaired delay mechanism, extreme self control may also be indicative of a disturbance in the delay function. Using a self report measure of impulse control, the (Self-Report Test of Impulse Control- STIC; Lazzaro, 1968) Woznica found that a restricting anorexic group scored higher than controls on the measure of impulse control, indicating greater control than the control group. The bulimic anorexic group on the other hand scored lower than the controls, indicating less control. Thus supporting that bulimic behaviours are associated with a breakdown in control, even when associated with anorexia. Garner et al. (1993) also investigated subgroups of anorexics but classified them according to the presence of purging behaviour as well bulimic behaviours thus giving three groups. Bulimic anorexics (who binged and purged), restricting (non-purging or bingeing) anorexics and restricting purging anorexics. The restricting purging group did not binge but used purging behaviours. Garner et al. reported that the restricting group were younger than both the purging and the bulimic group. Furthermore they suggested that there is a small proportion of patients with eating disorders who can control their urge for food for protracted periods of time without experiencing loss of control. However they note that the control of restricting anorexics has a tendency to break down over time with many of the restricting anorexics eventually engaging in purging behaviour.

Using two different self-report measures of impulsivity, the IRS, Impulsivity Rating Scale (Lecrubier et al; 1995) and the BIS-10, Askenazy, Candito, Caci, Myquel, Chambon, Dacourt & Puech (1998) found that those with restricting anorexia did not differ from anorexics with bulimic symptoms on either measure of impulsivity. However a control group had significantly lower scores on the IRS than the whole anorexic group, thus indicating lower impulsive behaviour in controls. They did not however compare the controls with the subgroups of anorexics separately, and it was the bulimic anorexics who had the highest score on the IRS. A positive relationship was found between impulsivity as assessed by the IRS and anxiety as assessed by the Hamilton Anxiety Rating Scale (HARS) (Hamilton, 1969). Askenazy et al. (1998) suggest that there may be two types of impulsivity: the first being measurable by self-rating scales and being related to anxiety disorders, and a second which is more closely related to impulse control disorder and violence. This distinction is compatible with the notion that impulsivity is a multi-dimensional construct and may manifest in behaviour in different ways for different people and/or different disorders characterised by impulsive behaviour.

A few studies have used Cloninger's Tridimensional Personality Questionnaire, TPQ, with individuals with eating disorders. Whilst this does not measure impulsivity directly it measures harm avoidance, novelty seeking and reward dependence (refer to chapter 3 for a discussion of the TPQ). One of the sub scales of the novelty seeking factor is an impulsiveness scale. Brewerton, Hand and Bishop (1993) used the TPQ 100 item version with patients diagnosed with anorexia nervosa, bulimia nervosa or both according to DSM-III-R (APA, 1992) classification. Patients were tested at intake to an eating disorder program. All patients, regardless of the DSM classification, scored significantly higher than controls on the harm avoidance dimension, whereas only the bulimics (with and without AN) scored higher on the novelty seeking dimension. In turn those with bulimia nervosa had significantly higher scores on the novelty seeking scale than anorexics and those with both bulimia and anorexia.

Waller et al. (1991) also reported high novelty seeking and harm avoidance, and low reward dependence scores in a sample of bulimic women. The high novelty seeking in bulimia nervosa would be in line with impulsive and risky behaviour. However bulimics would be expected to be low on harm avoidance as they take health risks. The results may reflect the notion that risk-taking and impulsive behaviour, for some are domain specific. Whilst harm and risks associated with the pursuit of control over food intake and the desire for the perfect body, are not avoided, risks and harm in other areas may be avoided. Perhaps the reported effects are state dependent and not enduring traits. Brewerton et al. (1993) suggest that data at intake to an inpatient programme could be affected by acute illness and suggest that a repeated assessment on the TPQ at weight restoration and recovery is necessary to determine whether these characteristics reflect state or trait.

Strober (1980) found that adolescents hospitalised with anorexia nervosa (restricters) were more hostile and rigid than bulimic adolescents. However these differences were no longer significant after weight gain, suggesting that at least certain characteristics of those with anorexia are state dependent. In contrast Stonehill & Crisp (1977) reported avoidant and controlling tendencies to still be present after weight gain. Casper (1990) in a long term follow up of 8-10 years also found that women who had physically and psychologically recovered from anorexia nervosa (restricting type) were found to have greater than normal reserve and self-control than conventional norms.

Sohlberg et al. (1989) investigated the long term outcome of a sample of anorexics and bulimics. They found that impulsivity was a specific predictor of poor outcome at a follow up of on average 2.5 years later. After another 2.5 years (follow up time 2) impulsivity still predicted an eating disorder. Impulsivity in this study was an index sum score obtained by assessing the presence of binge eating, shoplifting, alcohol/drug abuse and suicide attempts.

Despite the known prevalence of women with clinical eating disorders who seek treatment, the actual prevalence of anorexia nervosa and bulimia nervosa in the community is unknown, as people may have the disorder for years before they either seek treatment or come to the attention of health care professionals. Furthermore there may be people who never come to the attention of health care professionals. Welch & Fairburn (1996) suggest that studies which have assessed comorbidity in bulimia nervosa are usually clinic based and results found may be due to Berkson's bias which results from the fact that people with two or more disorders are more likely to be found in treatment (Berkson, 1946, cited in Welch & Fairburn). Alternatively they suggest that comorbidity may make a person more likely to seek help and result in referral, than individuals with only one disorder.

Welch & Fairburn (1996) assessed comorbidity of bulimia nervosa in a community sample of women, recruited people through GP practices in Oxfordshire, who met diagnostic criteria for eating disorders. They found that 26% of the community sample had a history of anorexia nervosa and 90% of those with bulimia nervosa were not in treatment. The comorbidity of bulimia nervosa and disorders classified as impulsive (alcohol and drug misuse and deliberate self harm) were assessed. In addition to the bulimia nervosa group the study included two control groups, a normal control and a psychiatric control who were also recruited from the same population. Current alcohol consumption did not differ between the bulimic group and either of the control groups. However the bulimia nervosa group did have higher rates of deliberate self harm than the other two groups. Welch & Fairburn (1996) conclude that their study does not support a multi-impulsive bulimia personality but rather "that deliberate self-harm, alcohol misuse and drug misuse may each have different relationships with bulimia nervosa rather than reflect a common disorder of impulse control" (457). Alternatively this could indicate that different aspects of impulsivity are present in different disorders and that the manifestation of impulsivity is different for different people.

Heilbrun and Bloomfield (1986) used a cognitive impulse control score, derived from the error scores on four tasks, to compare female college students who showed high bulimic characteristics or high anorexic characteristics as measured by the eating disorder inventory (EDI, Garner, Olmstead & Polivy, 1983). The high bulimic group had poor cognitive impulse control compared to those who did not have bulimic characteristics (controls). There were no differences between those with anorexic characteristics and controls. Unfortunately a comparison was not done between those with anorexic characteristics and those with bulimic characteristics. Heilbrun and Bloomfield claim that the DSM-III diagnostic criterion for bulimia of 'not being able to stop eating voluntarily' places "the person's anticipated loss of control at the heart of the disorder" (p 219).

5-HT dysregulation in eating disorders.

Goldbloom & Garfinkel (1990) proposed 'the serotonin hypothesis of bulimia nervosa'. They suggested that in the central nervous system of those with bulimia nervosa there is functional underactivity of serotonin. Furthermore Wolfe et al. (1997) suggested that altered 5-HT may contribute to binge eating in bulimia nervosa. There is evidence for this as manipulations of the 5-HT system result in changes in feeding behaviour, particularly in satiety responses. Brewerton (1995) suggests that satiety responses are impaired in bulimic patients and notes that in animals and man pharmacological enhancement of the 5-HT system generally results in increased satiety. In addition a reduction in serotonergic function has been found to result in an increase in meal size (Goodall & Silverstone 1988). Jimerson (1990) had previously noted that decreased satiety, depressed mood and increased impulsivity are all associated with decreased central 5-HT function. Brewerton et al., (1990) also suggested that impulsivity is linked to reduced serotonin functioning. Based on the above findings, and that both impulsive and depressed behaviour are seen in bulimia nervosa (Jimerson et al., 1990; Wolfe et al. 1994) and that these behaviours have been suggested to be due to dsysregulation of the serotonergic system (Jimerson, 1990). Wolfe et al. (2000) also suggested that impaired functioning of the serotonergic system may play a role in the symptoms of bulimia nervosa. Wolfe et al. (2000) found that a group recovered from bulimia nervosa had significantly increased serotonergic neuroendocrine response compared to a group with bulimia nervosa.

Dysfunction of the serotonergic system has also been postulated in anorexia nervosa. Selective serotonin reuptake inhibitors (SSRIs) are a class of antidepressant drugs that have been used to treat anorexia. The hypothesis being that underweight individuals with anorexia nervosa have lower concentrations of the 5-HT metobolite 5-HIAA (Kaye et al., 1988). These 5-HT reductions are hypothesised to be state dependent as once weight gain occurs CSF 5-HIAA levels are elevated. Kaye et al., (1984, 1988) reported that CSF concentrations of the 5-HT metabolite 5-HIAA were reduced in underweight anorexia nervosa compared to after weight gain or when compared to healthy controls. Brewerton et al. (1990) reported that the findings of Kaye and colleagues suggest that the results appear to be state dependent due to starvation. This suggests that low 5-HT function is a result of starvation and not a cause of disordered eating in anorexia nervosa. Kaye (2002) reported that neurotransmitter abnormalities that remain after recovery may indicate trait disturbances rather than contributing to the disorder. O'Dwyer et al. (1996) have suggested that dysfunction of the serotonergic system may be a contributing factor to abnormal eating habits and co-morbid psychopathology in anorexia nervosa. However they found no difference on a d-fenfluramine (a 5-HT releasing drug) challenge between weight restored anorexics and current underweight anorexics or controls. Kaye (2002) noted that the only way to establish what is cause and effect in anorexia nervosa and bulimia nervosa is to study these people at various stages in their illness.

Blood levels of both free tryptophan and total tryptophan (indices of central 5-HT concentrations), and ratio of tryptophan to LNAA, (large neutral amino acids) were decreased in an anorectic group compared with controls. There were however no differences between the anorexics with bulimic symptoms and the anorexic patients without bulimic symptoms on the biological indices (Askenazy et al., 1998). The data on 5-HT in bulimia nervosa and anorexia is not clear, but does suggest that reduced 5-HT function in bulimia nervosa may precede the eating disorder and a reduced 5-HT function in anorexia nervosa may be a result of starvation rather than a cause.

The literature suggests that for some women with bulimia nervosa problems with impulse control are evident and are not restricted to eating behaviour alone. Those with anorexia nervosa are characterised by greater control and whether this a state dependent effect of starvation or whether this behaviour persists after weight gain is inconclusive.

The present enterprise aims to assess impulsivity in women with bulimia nervosa and anorexia nervosa using the self-report questionnaire (the I-7) and the behavioural measures of impulsivity outlined in chapter 3. Bulimics would be expected to score higher on the measures of impulsivity than both controls and anorexics whereas the anorexics would be expected to score lower than the controls.

2.4. Impulsivity and risk-taking associated with drug use.

Another DSM-IV disorder that is associated with impulsive behaviour includes drug and alcohol misuse and abuse. The DSM-IV (1994) criteria for substance dependence notes that "the key issue in evaluating the criterion is not the existence of the problem, but rather the individual's failure to abstain from using the substance despite having evidence of the difficulty it is causing" (p179). Many individuals who use (but do not abuse) drugs often use more than one drug (polydrug users) (Morgan, 1998; Schifano, 2000) and this suggests risk seeking behaviour and impaired impulse control. Furthermore studies using the impulsivity subscale of the Eysenck Personality Inventory (EPI) with drug abusers have reported higher impulsivity scores than non-abuser control groups (King, Jones, Scheuer, Curtis & Zarcone, 1990).

Research on the construct of impulsivity with drug use has focused mainly on drug abusers, and not recreational drug users, with the exception of the recreational drug 'ecstasy' (MDMA). Substance abuse is when the substance (drug) is used frequently throughout the day and the person is often intoxicated and fails to abstain or carry out commitments (DSM-IV, 1994). There is no physiological dependence on the substance associated with substance abuse, unlike substance dependence. Drugs can be used without a person developing a substance abuse disorder. As impulsivity can be viewed as a trait which is on a continuum, then an adequate assessment of the construct of impulsivity needs to include populations who are considered to have problems with impulse control, as in the clinical disorders, and others who display impulsive behaviours but not at a clinical level.

Theories on why individuals take drugs are varied. One theory is that drug use is a form of risk taking and is prompted by self-destructive impulses (Plant, 1995). Personality variables have also been postulated as reasons why individuals take drugs, with hostility being one such trait (Plant, 1995). As impulsivity is a symptom of drug misuse and abuse in DSM-IV (APA, 1994) then it may be a personality trait that is present in individuals who take recreational drugs. However whether impulsivity is a personality trait stable across domains and situations or whether it is domain specific is unclear. Wingrove & Bond (1997) suggest that a person may behave impulsively in certain situations and this may be a stable characteristic but the tendency to behave impulsively per se may not be. However it could be argued that situation specific impulsivity is more indicative of a state rather than a trait dependent behaviour.

McGown (1988) reported that poly-drug abusers scored significantly higher on an impulsivity questionnaire than abusers of a single substance. Allen, Moeller, Rhoades & Cherek (1998) also reported that adults with a history of drug dependence (past but not currently dependent) scored significantly higher on both the venturesomeness and the impulsiveness scales of the I-7, and on the Barratt Impulsiveness Scale (BIS-11) than adults with no drug use history. Allen et al. (1998) in addition to the self-report measures of impulsivity also used a behavioural paradigm to assess differences in impulsivity between the drug dependent group and the non drug use group. In a choice paradigm task where there was a choice between a smaller immediate reward and a larger later reward, with impulsive choices defined as those where the individual chooses the smaller immediate reinforcer, the drug dependence group made more impulsive choices than the non drug use group. The longest delay that the drug dependence group tolerated to receive the larger delayed reward was shorter than for the non drug group. These differences were not however significant. This choice of the smaller immediate reinforcer is also referred to as the discounting of delayed rewards. Heroin addicts have increased discounting of delayed rewards in favour of an immediate smaller reward (Kirby, Petry. & Bickel, 1999). Psychiatric outpatients who engaged in impulsive behaviour, 58% with substance abuse disorders, 33% with borderline personality disorder and 8% with bipolar disorder, also showed greater discounting of delayed reward than low impulsive outpatients (Crean, de Wit & Richards, 2000).

Lane & Cherek (2000) investigated risk taking in two groups. They divided their participants into high risk or low risk groups. The high risk participants were defined according to having met at least two of the following criteria. 1) Meeting DSM-IV criteria for past drug/alcohol dependence, (2) Meeting DSM-III-R criteria for conduct disorder by age 15, (3) Onset of drug use by age 16 and/ or, (4) a history of criminal activity and arrest. Forty-six percent (of 13) of the high risk group met criteria for conduct disorder and 62% for past drug/alcohol dependence compared to none in the low risk group. All of the high risk group had used illicit drugs and all had been convicted of a criminal offence. Only 2 of the 13 low risk group had been convicted of an offence. They found that the high risk group made significantly more risky responses than the low risk group in a risk taking task that measured preference for a risky option over a less risky option. There were no significant differences on the BIS-11 between groups and the correlation between risky responding on the gambling task and the BIS-11 was non significant.

The results of Lane and Cherek's study, showing that a history of risk taking behaviour correlates with a behavioural measure of risk taking but not with a self report measure of impulsivity further demonstrates the lack of correlation between different aspects of impulsivity. They also show that some self-report measures of impulsivity are not always effective in detecting differences between groups. Overall the findings of Lane &

Cherek suggests that in some groups risk taking is not domain specific and that risk taking (or impulsive) behaviour can manifest itself in different ways. The behaviours (drug abuse, conduct disorder, criminal activity) that Lane & Cherek used to classify their high and low risk groups are also behaviours that not only involve risk but can be considered to be impulsive in nature. Furthermore all of the high risk group had been convicted of a criminal offence. This may reflect H.J Eysenck's claim that there are two types of criminals, those who are impulsive and get caught and those who are not impulsive and are never brought to trial for their crimes (Eysenck, 1977).

As mentioned (in chapter 1) impulsivity is viewed as a personality trait by some (Eysenck 1978; Eysenck et al., 1985) and a trait measure of impulsivity (I-7) was devised by Eysenck et al. (1985). The I-7 was used in a study by Morgan (personal communication) to investigate the effects of smoking on impulsive behaviour. Smokers who had been abstinent from smoking for 2 hours had significantly higher I-7 impulsiveness scores than smokers who had recently had a cigarette. The recent smokers had the lowest scores. On behavioural measures the smokers had the highest impulsivity score and the non-smokers the lowest. This suggests that higher behavioural impulsivity seen in smokers may be a state dependent effect of the drug. However trait impulsivity was highest in those who had abstained from smoking for two hours.

McGown (1988) found that multiple substance abusers scored significantly higher on trait impulsiveness (I-7) than individuals with single substance abuse. Multiple substance abusers were classified as such by having used two or more substances either serially or in combination. Kennedy and Grubin (1990) assessed the relationship between trait and behavioural impulsivity, and drug use in sex offenders. Assessment of drug use included alcohol abuse, sedative and cannabis abuse, and other drug abuse, which was of amphetamines, cocaine and heroin. Trait impulsivity was assessed using an earlier version of the I-7, the I-5, and behavioural impulsivity was assessed according to the number of impulsive disorders a person had. The impulsive disorders assessed were self-harm, pathological gambling, repeated aggression, alcohol abuse, sedative abuse and other drug abuse. They reported a linear correlation between I-5 impulsivity scores and the number of impulsive disorders. They also reported that other drug abuse was significantly associated with both alcohol and sedative abuse. Neither self-harm nor gambling correlated with any of the other impulsive behaviour. This lends some support for an association between drug use and impulsivity.

The literature on substance abuse and impulsivity shows substance abuse and impulsivity do co-occur. Substance abuse also coexists with other DSM-IV disorders such as the personality disorders. Furthermore those with ADHD tend to have higher rates of substance abuse than their peers. High rates of alcohol and substance abuse have also been reported in women in bulimia nervosa (Lacey, 1993). Thus it seems that some of these behaviours and disorders that are characterised by impulsivity seem to co-exist, and as the number of impulsive behaviours an individual engages in increases, so the poorer is the prognosis for treatment. Thus it would seem from the literature that not only does substance abuse co-exist with other psychiatric disorders but many of the disorders it does co-exist with are those characterised by impulsive behaviour.

The broad aims of the drug use chapter (chapter 8) were to investigate impulsivity and risk taking behaviour in a group of recreational drug users, using self-report measures. As will be outlined in chapter 8 interest was specifically in the use of the illicit substance 3,4-methylenedioxymethamphetamine (MDMA), commonly known as 'ecstasy' as it has been linked to impulsive behaviour (Morgan, 1998) and animal studies have shown that treatment with MDMA results in depletion of the neurotransmitter 5-HT (Steele et al, 1994) with studies suggesting similar results in humans (McCann et al 1998). Furthermore lowered 5-HT has also been linked to impulsive behaviour (Brewerton et al., 1990; Virkkunen et al; 1994). Consequently ecstasy users are a particularly interesting group for two reasons: (i) drug use is associated with impulsivity and (ii) ecstasy use may cause 5-HT depletion, thus providing a second reason to predict increased impulsivity.

2.5. Rationale for the current research.

The literature reviewed in the first two chapters identifies seven main issues surrounding impulsivity. These are:

1. The lack of consensus on how to define impulsivity.
2. The general agreement that impulsivity is a multidimensional construct contrasts with the persistence, by some, in using a single measure to assess impulsivity.
3. The lack of inter-correlations between self-report and behavioural measures of impulsivity and within the self-report and behavioural domains.
4. Is risk-taking behaviour an aspect of impulsivity, or a separate construct that co-occurs with impulsive behaviour?
5. As impulsivity is manifest in behaviour in different ways, different people categorised as being impulsive may not be behaving in the same way.
6. The majority of impulsive behaviours and disorders with impulse control problems appear to be characterised by dysfunction of the serotonin system.
7. Impulsivity is both a symptom of clinical disorders and a behaviour distributed throughout the population. Research needs to address this issue by investigating impulsivity in both clinical and non-clinical populations.

An exhaustive analysis of impulsivity would need to incorporate the use of different populations, including those in whom impulsive behaviour should be expected. Due to the multi-dimensional nature it should also use a variety of measures that capture different aspects of impulsivity. The use of a single self-report or behavioural measure of impulsivity may be one reason why many earlier studies investigating the construct of impulsivity have found conflicting results: if different measures are being used it cannot be claimed that they are measuring the same thing. A unified common definition of impulsivity is difficult given the multi-dimensional nature of impulsivity. What researchers need to acknowledge is that they may only be measuring a narrow aspect of impulsivity when they use either a single self-report or a single objective measure of impulsivity.

The present research will attempt to address the issues of (i) whether there are common elements of impulsivity in the different populations, and (ii)whether impulsivity seen in these groups is narrow or involves different behaviours which reflect different aspects of the construct. The literature suggests that for some people with bulimia nervosa and/or substance abuse more than one impulsive behaviour is present. These issues will be addressed by asking the following research questions.

1). Are there common elements of impulsive behaviour across different populations (clinical and non-clinical) which contain an element of impulsivity?

2). Is impulsivity narrow or wide as assessed by different measures believed to tap into different aspects of impulsivity?

3). Is there any relationship between the self-report measures and the behavioural measures of impulsivity?

4). How is performance on a financial risk taking measure related to impulsive behaviour?

The aims of this thesis will be addressed by using a variety of measures of impulsivity which are believed to tap different aspects of impulsivity. These measures will first be piloted on the populations to test their suitability for use with either the age range or the clinical population. The measures common to all studies are outlined in chapter 3. These measures will be given to non-clinical populations and clinical populations in whom there is reason to believe, due to their disorder, that there are problems with impulse control, either behaving impulsively or with self-control. The clinical populations chosen were children and adolescents with ADHD and women with the eating disorders of anorexia nervosa and bulimia nervosa. A population of drug abusers or drug addicts (substance dependence) presents difficulties in testing when drug free, so a population of people in the age range of those who use illicit substances were recruited to look at impulsivity in recreational drug users and especially the drug 'ecstasy' (MDMA). As the factors or aspects of impulsivity are not agreed upon and remain unclear, especially that between impulsivity and risk-taking. Due to this a measure of financial risk taking behaviour will be developed to assess risk taking behaviour and the relationship of risk taking to impulsivity and the clinical disorders. The development of this measure, Bets-16, is covered in detail in chapter 4.

Chapter Three

Methodology

3.0 Introduction.

Many of the studies in this thesis have used some common measures which are outlined in this chapter. Where any additional measures or tasks have been used these are described in the methods section of the relevant chapter(s). Measures of impulsivity can be divided into self-report (subjective) and behavioural (objective) measures. The self report measures are typically pencil and paper questionnaires that contain various scales that have been subjected to factor analysis. The measures outlined here, which are used throughout the thesis, were chosen as they assess different aspects of impulsivity.

3.1 Participants.

Undergraduate psychology students from the University of Greenwich participated in various studies in this thesis either to obtain research participation credit or as part of the undergraduate programme unit Research Methods in Psychology. In all studies written informed consent was obtained, with participants being informed of their right to withdraw, confidentiality and anonymity. All participants were debriefed, either at the end of their participation or at the end of the experiment. Ethical approval for research with the ADHD group and controls and the drug use studies was obtained by the University of Greenwich Research Ethics Committee. The participants with anorexia nervosa and bulimia nervosa were recruited from an eating disorder unit in Kent and the study was approved by the Local Research Ethics Committee prior to commencement.

3.2 Self-report questionnaires.

Self-report measures of impulsivity are amongst the most commonly used to assess impulsivity. This may be due to their ease of administration. They typically take the form of questionnaires which contain subscales that have been subjected to factor analysis. One of the most commonly used self report questionnaires is the I-7.

3.2.1 I-7 (Eysenck, S.B.G., Pearson, P.R., Easting, G. & Allsop, J.F. (1985).

This is a pencil and paper self report questionnaire which developed from work by Hans Eysenck and Sybil Eysenck in the 1970s to measure two aspects of self reported impulsivity. It is also referred to as the Impulsiveness, Venturesomeness and Empathy Questionnaire or the Impulsiveness Questionnaire (IVE). It is a 54 item questionnaire and contains three scales (see appendix VI). The three scales are Impulsiveness, Venturesomeness and Empathy. It is a forced choice questionnaire to which respondents answer yes or no to each of the 54 questions. It is suitable for ages 16 +. Instructions are given at the top of the questionnaire and are as follows.

I-7 Instructions.

Please answer each question by putting a circle around the 'YES' or 'NO' following the question. There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about each question.

Impulsivity as measured by the I-7 is viewed as a personality trait. Impulsivity items were originally part of the Eysenck Personality Inventory (EPI) and they were aligned with Eysenck's extraversion dimension. According to Eysenck & Eysenck (1991) the typical extravert "acts on the spur of the moment, and is generally an impulsive individual." (p 4). When the Eysenck Personality Inventory was changed in 1975 to the Eysenck Personality Questionnaire (EPQ) and a new variable of psychoticism was introduced they found that some of the impulsiveness items were more aligned with the psychoticism scale whilst other items remained aligned with extraversion. Eysenck and Eysenck (1978) claimed that from this it was clear that impulsiveness was not a unitary factor and they constructed a separate questionnaire to measure impulsiveness. An initial 63 item questionnaire (I-5) was developed to measure two scales of impulsivity. One scale measures impulsiveness, where the items are more akin to psychoticism and the second scale measures venturesomeness, which is the extraverted type of impulsiveness. The empathy scale was originally included as buffer items to break up a list of similar looking questions. From the 63 item version I-5 came the current I-7 54 item questionnaire (Eysenck et al., 1985).

Eysenck et al. (1985) reported correlations between impulsiveness and venturesomeness of 0.35 for males and 0.38 for females. Eysenck and Eysenck (1991) maintain that although from a psychometric point of view the correlations are not desirable, it is however not surprising to find such correlations as both scales are measuring aspects of impulsivity. Thus they treat impulsivity not as a unidimensional construct, but one with two aspects to it.

The I-7 has been validated and widely used. Test retest coefficients and internal reliability reported by Eysenck & Eysenck (1991) are presented in table 3.2.1.

Table 3.2.1. One month test retest coefficients and internal reliability of the I-7 scales for males and females. Adapted from Eysenck and Eysenck (1991).

	Males		Females	
	test retest reliability	internal reliability	test retest reliability	internal reliability
	n = 109	n = 383	n = 120	n = 206
Impulsiveness	0.78	0.84	0.86	0.83
Venturesomeness	0.85	0.85	0.90	0.84
Empathy	0.77	0.69	0.77	0.69

Eysenck et al (1985) conclude their article by claiming that the three scales of the I-7, Impulsiveness, Venturesomeness and Empathy are three robust factors. Although Impulsiveness and Venturesomeness are correlated with each other they are each measuring a different type of impulsivity.

Impulsiveness.

This scale contains 19 items. Impulsiveness is used to refer to behaviour that is impulsive in nature, where the individual gives no forethought to the consequences of behaviour. It involves risk where the individual is not aware of the risk involved in their behaviour. Eysenck and Eysenck (1991) view Impulsiveness as the pathological or abnormal aspect of risk taking behaviour. A score between 0-19 is obtained on impulsiveness, with higher scores reflecting more impulsiveness.

Venturesomeness.

This scale contains 16 items and is considered to measure risk taking behaviour where the individual is aware of the risks involved but engages in the behaviour anyway, just for the thrill of it. A score between 0-16 is generated. Higher scores reflect greater venturesomeness behaviour.

To distinguish between Impulsiveness and Venturesomeness and to describe the concepts Sybil Eysenck (1993) uses an analogy of a driver who drives their car around a blind bend on the wrong side of the road. She claims that the driver who scores high on the Impulsiveness scale does not consider the danger involved with such behaviour and if an accident occurs the person is genuinely surprised. The driver who scores high on the Venturesomeness scale on the other hand, considers the risks and engages in the behaviour anyway for the "...thrill of the sensation seeking arousal caused by what he hopes will be merely a near miss" (p 144). Zuckerman (1993) notes that the venturesomeness scale of the self-report questionnaire the I-7 (Eysenck et al, 1984) mainly consists of items relating to physical risk taking and thrill and adventure seeking.

Empathy.

The empathy scale consists of 19 items which measure how well a person empathises with another. This was originally a 21 item scale in the I-5 and the items came from an established scale (Mehrabian & Epstein,1972; cited in Eysenck & Eysenck, 1991). A score of 0-19 is obtained. Again higher scores reflect more empathy.

Mean scores by age from a selection of the age ranges reported by Eysenck & Eysenck (1991) are presented in table 3.2.2. Mean scores are given for those age ranges which have been used in this thesis.

Table 3.2.2 Means (± standard deviations) for the three I-7 scales. Adapted from Eysenck and Eysenck (1991).

Age group	Impulsiveness	Venturesomeness	Empathy
16-19	9.84 (± 4.13)	11.51 (± 3.34)	12.47 (± 3.28)
20-29	7.93 (± 4.12)	10.31 (± 3.73)	11.76 (± 3.17)
30-39	7.06 (± 4.20)	7.25 (± 3.70)	11.87 (± 3.36)

In addition to the age ranges reported above in table 3.2.2 Eysenck and Eysenck (1991) report mean scores for a range of participants aged 16 to 89 years old.

The I-7 was chosen to be used in this thesis as impulsivity is not treated as a unidimensional construct, and the I-7 contains two impulsivity scales, impulsiveness and venturesomeness, which have good reliability. Mean scores are available for males and females for ages from 16 –89 years. It has been widely used with numerous different populations, including drug users (Morgan, 1998) and women with eating disorders (Fahy & Eisler, 1993). It is quick and easy to administer, taking approximately 15 minutes for participants to complete, and has been one of the most extensively used self-report questionnaires of impulsivity. There is also a junior version of the I-7 , which is the I-6, and this is suitable for ages 8-15 (Eysenck et al; 1984). This will be outlined in chapter six.

3.2.2. Tridimensional Personality Questionnaire (Heath et al. (1994).

Cloninger (1987a) proposed a model of personality that links his three personality variables with neurotransmitter systems. It is described as " a unified biosocial theory of personality..." (Cloninger, 1987a, p 574). Whilst the three factors in Cloninger's model are harm avoidance HA, novelty seeking NS and reward dependence RD, the harm avoidance contains an impulsivity subscale. According to Cloninger impulsivity is related to serotonin mediated behavioural disinhibition, and novelty seeking is related to behavioural activation mediated by dopamine.

Cloninger proposed the three factors to personality, novelty seeking (NS), harm avoidance (HA) and reward dependence (RD) and Cloninger et al (1991) constructed a 100 item questionnaire, the Tridimensional Personality Questionnaire (TPQ) to measure these three personality traits. This is a pencil and paper task in which participants respond true or false to the 100 items. Heath et al (1994) devised a short form of the TPQ which consists of 54 items from the original 100 items. Each scale of the 54 item version contains 18 items, generating a score of 0-18 for each scale. Participants respond true or false to the 54 items in the questionnaire. The 54 item version of the TPQ was used in this thesis.

Instructions were brief and as follows:

Read each statement carefully, but don't spend too much time deciding on the answer. Please answer every statement. Remember there are no or right answers - just describe your own personal opinions and feelings.

Internal reliability (Cronbach's alpha) and test retest coefficients reported by Heath et al (1994) for females and males are shown in table 3.2.3

Table 3.2.3. Test retest reliability and internal reliability (consistency) of the three scales of the 54 item TPQ. Males n = 430 and females n = 451. Heath et al. (1994).

	Males		Females	
	test retest reliability	internal reliability	test retest reliability	internal reliability
HA	0.73-0.83	0.78-0.85	0.76-0.84	0.83-0.85
NS	0.68-0.80	0.68-0.73	0.70-0.82	0.66-0.77
RD	0.62-0.71	0.58-0.68	0.59-0.76	0.59-0.62

HA = harm avoidance, NS = novelty seeking, RD = reward dependence.

The test retest interval on the data reported in table 3.2.3 was on average 2.1 years. Age was in the range of 18-88 for the entire sample. Heath et al (1994) reported that the test retest reliability coefficients were a little smaller than the six month test retest reliability coefficients of the 100 item version. They note that this was to be expected as the time interval between test and retest was much longer for the 54 item version and this also has fewer items in each scale.

Heath et al. reported that there were no sex differences on scores for Novelty Seeking but women scored higher than men on both Harm Avoidance and Reward Dependence. Mean scores for males and females reported by Heath et al (1994) are given in table 3.2.4

Table 3.2.4. Mean scores for novelty seeking (NS), harm avoidance (HA) and reward dependence (RD) on the 54 item version of the TPQ. Heath et al (1994)

	NS	HA	RD
Males	7.38	5.94	9.90
Females	7.20	7.92	11.52

Cloninger (1987a) proposed that there is an underlying genetic factor to personality. He also proposed that each of the three different personality factors were linked to different neurotransmitter systems. Individuals who score high on novelty seeking tend to be impulsive, extravagant, quickly bored and ready to engage in new activities. Novelty seeking is considered to be associated with low activity of the dopamine neurotransmitter system, and to be related to brain systems involving behavioural activation.

Harm avoidance is hypothesised to be related to brain systems involving behavioural inhibition. Individuals who score high on harm avoidance are cautious and shy, and thought to have increased 5-HT (serotonin) activity. Those who score high on reward dependence are sensitive to social cues, and likely to delay gratification if they expect reward and this dimension is associated with low noradrenergic activity (Cloninger, 1987a). Reward dependence is related to brain systems that are activated by the onset of reward and the offset of punishment (Wills et al 1994).

The TPQ was used in some of the studies in this research due to its previous use, albeit in a limited number of studies, with individuals with eating disorders, and drug abuse problems. The novelty seeking scale also contains items that form an impulsivity subscale in the 100 item version. The 100 item version was deemed too long to administer with the other tasks and as the 54 item version had good reliability and correspondence with the 100 item version it was decided to use the 54 item version of the TPQ.

3.3. Behavioural (objective) measures of impulsivity.

As noted in chapter one, there are many different objective measures of impulsivity that can be used. One of the most common is the Matching Familiar Figures test (Kagan, et al 1964). The MFFT was not included in the battery of tests in this thesis due to problems reported with it. The objective measures chosen were a financial risk-taking measure, the Bets-16, and an operant choice paradigm, 'Hungry Kevin'. The Bets-16 was developed to measure the risk taking aspect of impulsivity and the development of this measure is outlined in chapter 3. An operant choice paradigm was chosen to assess the inability to tolerate delay / delay gratification aspect of impulsivity.

3.3.1. Bets-16.

The development of the Bets test is covered in chapter 4 so only a brief outline of the task is given here. This is a pencil and paper task which consists of 5 pages. Page one contains the instructions and a practice trial. Pages 2-5 have 16 pairs of hypothetical bets (or gambles) and participants are to choose between bets in each pair. The bets are represented in pie chart format and the each pie is divided into two portions. The pair of bets are labelled 1-16 and within each pair one of the options is labelled A and the other option labelled B. Choice is indicated by circling either option A or B for each of the 16 pairs. One of each pair is a risky bet and the other option of the pair is a safe bet or risk averse. A score between 0 and 16 is obtained by adding up the number of risky bets chosen. The risky bet is the option in each pair that has a large chance of winning nothing and a small chance of winning a larger amount of money. The other option has a definite win of one of two smaller amounts. However the test retest reliability and internal consistency have not yet been established and these are determined in chapter four, along with mean scores for females and males.

3.3.2 Operant choice paradigm (Hungry Kevin).

The operant choice paradigm is a well established laboratory task for measuring impulsivity. Within this area impulsivity is defined as the choice of a smaller more immediate reinforcer over a larger delayed reinforcer (Ainslie,1975). The other choice, that of the larger delayed reinforcer is the self-control choice. In a typical choice paradigm participants are presented with a choice between two schedules of reinforcement, one schedule gives a smaller immediate reinforcer and the other schedule a larger delayed reinforcer. The choice is usually made by responding on one of two buttons. Responses on the button which produces the smaller immediate reinforcer are referred to as the impulsive choice, and responses on the button which produces the larger delayed reinforcer are termed self-controlled (Ainslie, 1975). In humans reinforcement can either be an immediately consumable reinforcer such as food or access to a video game or slides, or it can be a secondary (conditioned) reinforcer such as points earned which are exchanged for money or food at the end of the experimental session. Typically studies with secondary reinforcers have found it difficult to demonstrate impulsivity (Logue et al, 1986). Studies with immediately consumable reinforcers such as access to a video game have reported only a limited degree of impulsivity (Millar & Navarick, 1984). Another immediately consumable reinforcer, access to viewing slides of entertainment and sports personalities produced impulsiveness in only a few participants (Navarick, 1986).

A typical operant choice paradigm involves a number of time periods. First participants are presented with a choice and following their choice there may or may not be a pre-reinforcer delay. Pre-reinforcer delay is the time which participants are required to wait prior to receiving the reinforcer. This is followed by access to reinforcement and may be followed by a post reinforcement delay. The post reinforcement delay is defined as "the time between the end of access to reinforcement and the start of the next choice" (Logue,1988, p667). Typically the impulsive choice does not involve a pre-reinforcer delay. There are two main properties of reinforcement in a choice paradigm, the amount of reinforcement and the reinforcement delay.

The operant choice paradigm 'Hungry Kevin' was written by staff at London Guildhall University and has been used there extensively with children and adults. 'Hungry Kevin' is a DOS based computer task which uses an operant choice paradigm with schedules of delayed reinforcement, that is, individuals are reinforced after each operant response, but after a delay. The delay they receive is dependent upon the choice they make. The choice keys used in 'Hungry Kevin' are the w key of the keyboard coloured white with a white adhesive circle and the b key of the keyboard coloured blue with a blue adhesive circle. Choices are made by pressing either the blue key or the white key when given the option.

Reinforcement is an immediately consumable reinforcer which is access to a pacman style game, where the round face of 'Hungry Kevin' is moved around the screen. The game 'Hungry Kevin' consists of a circular face of 'Hungry Kevin' which is moved up, down, left and right on the VDU screen by the arrow keys on the keyboard. Instructions appear on the screen at the start of the game (see below). The object of the game is to eat the balls numbered 1 to 9 that appeared on the screen. When a numbered ball is eaten the number on the ball is multiplied by one hundred and added to the participants score which appears throughout the game in the bottom right hand corner of the screen. After a ball has been eaten a trapdoor appears in its place. If 'Hungry Kevin' is moved over a trapdoor points are deducted from the score. When all the balls on the current frame have been eaten a new frame appears with more numbered balls plus the trapdoors from the previous frame. As the frames advance 'Hungry Kevin' became faster and the game becomes more difficult. There are seven frames, and for each frame the background is a different colour.

Instructions.

The instructions for the game appeared on the screen at the start of the game and were as follows.

This game is called 'Hungry Kevin'. The object of the game is to move 'Hungry Kevin' about to eat the numbered balls that appear on the screen. The arrow keys move 'Hungry Kevin' left, right, up and down. When a numbered ball is eaten, the number on the ball is multiplied by 100 and added to your score, which appears in the bottom right hand corner. After a numbered ball is eaten a trap door appears in its place. Be careful not to run over these trap doors as points will be deducted from your score. Also be careful not to run into the walls, as this may reset the game back to frame one. The game will be interrupted from time to time and you may have to wait. You will be asked to choose a key to continue the game. One of the following messages will appear on the screen "press the blue key", "press the white key", or "press either key". The key you choose may affect the length of time you have to wait before the game begins and the length of playing time before the game is interrupted again. Instructions will appear across the top of the screen as you go along. As the game progresses and 'Hungry Kevin' eats more balls, more trap doors appear on the screen, thus making the game more difficult. You will now have a few practice trials. Press the space bar to begin.

After participants have read the instructions the arrow keys are indicated on the keyboard and they are instructed that at the start of the game, after the practice trial, they will be instructed which key to press. They are told to pay attention to what happens with the blue key and white key. They are informed that the game takes 15-20 minutes to complete regardless of which key they press and that if they lose all their points and go back to frame one their time does not start again just the level of the game. They are then asked if they have any questions. Questions are dealt with and participants are then instructed to press the space bar to start the practice.

Participants are given a short practice session at the start to familiarise themselves with moving 'Hungry Kevin' around the screen. After the practice session there were four forced trials (2 blue button responses and 2 white button responses) which began the experimental session.

screen then went black and 'Please wait' appeared at the top of the screen, the time participants had to wait varied for the blue button schedule in different conditions. There are four conditions but for most of the studies in this thesis only condition 2 was used. The contingencies operating under each of the keys is outlined in the relevant chapter. There were never any pre-reinforcement delays with the white button schedule. The white button always represented the impulsive choice. After the pre-reinforcement delay participants then received reinforcement - access to the game. The reinforcement time depended upon which choice of button participants had made. After the reinforcement time was completed the screen went black again and "Please wait" appeared across the top of the screen, and the post reinforcement delay occurred which was six seconds in all conditions for both the blue and white button. The game proceeded like this until the session was complete. The session length was preset to deliver a set amount of reinforcement. This was equivalent to either 10 or 20 free choices of the blue button. Session length varied for different conditions. As the delay to larger later reinforcer increased across conditions so too does the session length. Reinforcement densities between the two choice schedules were kept equal, so that regardless of the choice made participants received the same amount of reinforcement, or access to the game. This also meant that the session length was not dependent upon the choice made and session length was approximately the same regardless of their choice.

Scoring.

Scores can either be the proportion of impulsive responding or the percentage of impulsive responding. The proportion of impulsive responding is derived by adding up the total number of impulsive choices made and dividing this by the total number of free choices made (impulsive plus self-controlled). A score between 0 and 1 is generated, with a choice proportion score of above 0.5 indicating impulsive responding and below 0.5 self-controlled. This cut off point of 0.5 is consistent with other research (Forzano & Logue, 1992).

3.4. The continuous performance task: version 3 (CPT; Conners, 1995).

This is referred to in the manual as an attention test for research and clinical settings. The continuous performance task is a DOS based computer task which presents grey letters (approximately 1" in size) one at a time onto a black background. There are different paradigms that can be used. In all paradigms participants are to respond to a letter or to a series of letters. The AX paradigm was the paradigm used in most of the studies in this thesis. The task involves participants responding each time the series of letters AX appears, that is each time the letter X is presented but only if it had been preceded by the letter A. Responses are made by pressing the space bar. This is referred to as a target trial. For all other trials participants are required to do nothing and are actually required to withhold a response.

Written instructions, which appeared on the VDU at the start of the test, were as follows.

This test presents letters, one at a time. You are to quickly click (press and release) the LEFT mouse button (or press the space bar) each time a letter from the following list appears, but only if the previous letter was a A. Letter List: X

The instructions were then repeated verbally as follows. Participants were instructed to press the space bar (and the space bar was indicated on the keyboard) each time the letter X (this was pointed to on the written instructions) appeared but only if the previous letter had been an A (again the letter was pointed to on the screen). If the letter X appeared but the previous letter was not an A then do not respond. Participants were asked to repeat what the test required them to do. They were then informed that the test would begin as soon as they pressed the space bar and so when they were ready press the space bar to begin.

Each letter is displayed for 200 milliseconds. In the AX version there were 4 blocks of trials and each block contained 100 trials per block. For each 100 trials block, 10 trials were target trials. This gave a total of 40 target trials per session. The inter-stimulus interval was 1.5 seconds. Numerous details were collected and presented as a report. It took approximately 10 minutes for participants to complete the AX paradigm. Two scores which are of interest are the errors of omission and errors of commission. Errors of omission are when the participant failed to respond to the target letter on a target trial. Errors of commission are where the participant responded when the target letters were not presented (non-target trial). Mean reaction time for hits (responding on target trials) and errors of commission are given. Errors of omission are considered by Conners to be scores of inattention and errors of commission are an impulsivity score (Conners, 1995).

Due to the CPT measuring impulsivity and attention plus generating reaction time scores to targets and errors of commission this was considered a useful measure of impulsivity. Also it is a widely used measure both in research and clinical assessment of children and adolescents with ADHD. The CPT was felt to be a useful tool to assess the cognitive functioning of the women with clinical eating disorders, as impaired cognitive functioning has been found in women with eating disorders and differences found between controls and patients with eating disorders might be attributed to an impairment in cognitive functioning.

3.5 Statistical Analysis.

All experiments used between group designs. Analysis of variance (one way ANOVA) or t-tests were used to analyse differences between groups. Where significant group differences were found with ANOVA post hoc analysis was performed using Tukey's HSD test and a priori comparisons using t-tests. Where the assumptions of parametric tests were not met then non-parametric equivalent tests were used. All tests were two-tailed.

Correlation coefficients were computed to analyse the relationship between measures. This was Pearson's correlation coefficient where assumptions for parametric tests were met and the non-parametric Spearman's correlations when assumptions were broken.

Chapter Four

Development of the Bets Paradigm as an objective measure of risk-taking.

As mentioned in chapter one risk-taking behaviour has been postulated as one of the aspects of the impulsivity construct and research does support this (Cooper, et al., 2001; Gerbing et al; 1987). In addition to risk-taking being one possible factor of impulsivity, most impulsive behaviour includes some element of risk, be it in a financial, social, health or personal domain. Due to these factors an objective measure of risk-taking behaviour was sought. The studies in this chapter were carried out to develop a measure of risk-taking behaviour which was quick and easy to administer and was more objective than self-report questionnaire measures of risk-taking behaviour. As Steketee & Frost (1994) noted there was (is) a lack of adequate measures of risk-taking and the questionnaires that do exist to measure risk-taking reflect risk-taking activities of pleasure seeking, as opposed to the avoidance of risk. Another issue surrounding the development of the Bets paradigm was that many objective tests of impulsivity, such as those which measure reaction time, can also be considered to be measuring risk-taking behaviour. This is because fast responding can result in errors or inaccuracy. Whilst fast responding is not such a risky activity in laboratory tests, in the real world responding fast and inaccurately can result in injury and negative consequences. Also as many of the psychiatric disorders that impulsivity is implicated in are also associated with depression and depression is associated with psychomotor retardation, therefore a measure of risk-taking needed to be independent of speed of response.

The studies reported in this chapter were carried out to (i) establish mean scores for males and females on the bets paradigm (ii) investigate whether there were any differences in scores between males and females (iii) to investigate the test-retest reliability, (iv) internal reliability and (v) convergent validity of two versions of the Bets Paradigm, the Bets-16 and Bets-17[1].

4.0. Introduction.

Whilst Levenson (1990) claims that risk-taking can be physical or social, or a combination of both, Bromiley & Curley (1992) suggest that risk-taking can be addressed in four broad situations, everyday life choices, business settings, games and lotteries and physical situations. They claim that risk in physical situations has become narrowed to be almost synonymous with Zuckerman's sensation seeking scale. Zuckerman's sensation seeking scale is a self report questionnaire from which people choose one of two statements for each item. Sensation seeking, as measured by the Zuckerman scale, has been found to correlate with numerous behaviours that can be considered to involve physical risks, including multi-drug use, cigarette smoking, and participation in physically dangerous activities (Zuckerman, Buchsbaum & Murphy 1980).

[1] Originally 20 pairs of bets were developed for the Bets-17, however one pair was a replication of another and it came to light that two other pairs of bets did not have equal expected values. They were excluded from the scoring, leaving 17 pairs of bets.

The concept of risk is often discussed in relation to a choice between potential benefits and possible costs. Zuckerman & Kuhlman (2000) point out that in life "many decisions involve a balance between anticipated reward and risk" (p 999). Cooper et al (2000) give the viewpoint that risky behaviours involve a trade off between short-term gains and potential long term costs. Yates and Stone (1992a) note that most risk-taking situations involves a choice between two or more alternatives. This is the case in the second situation suggested by Bromiley & Curley (1992) in which risk can be assessed: that of games and lotteries. This usually involves a person choosing between alternative gambles that have uncertain outcomes. This is the case in the Bets Paradigm, which was developed to assess the risk-taking aspect of impulsivity.

Bets-16 had been piloted by Montgomery (Personal communication, September 1997) with promising results and had been developed from work by Edwards (1955) on subjective expected utilities. Edwards maintained that when individuals were given a choice between two simple gambles, such as in figure 4.1, then most people would choose gamble B. Edwards (1955) claimed that the reasoning behind peoples choices were that as you do not stand much chance of losing anything then it is preferable to choose a long shot of winning a reasonable amount rather than the certainty of winning a small amount. Edwards also found that when there was a low possibility of losing then people avoided choices that included the possibility of a loss. However the expected value of the two gambles is the same, in the case of figure 4.1 it is 14 pence in both gambles. Expected values are the average gain or loss that a person would expect from repeatedly playing the gamble.

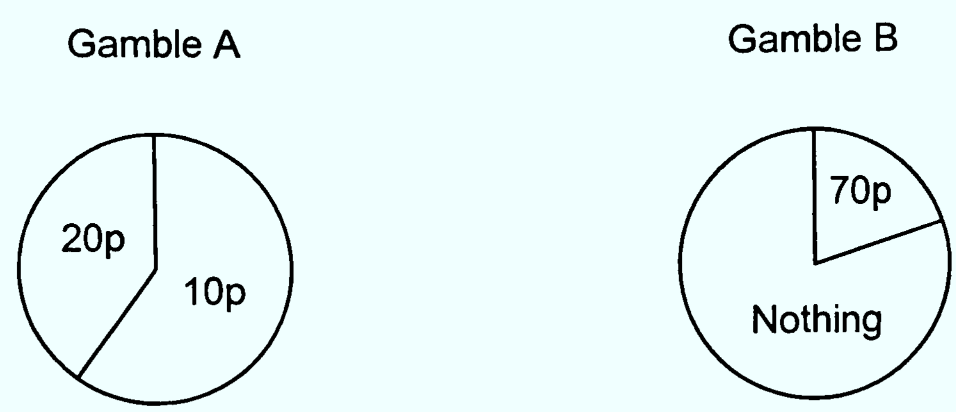

Figure 4.1. An example of a simple gamble with equivalent expected values. Adapted from Wright (1984).

Edwards (1955) defined the expected value (EV) of a bet as "the amount which a gambler will receive as a result of making it, on the average" (p201). Therefore in figure 4.1 a person would expect to gain 14 pence on average. This is calculated by multiplying the probability of each outcome by the value to be won or lost in the gamble and then adding them together. In figure 4.1 the expected value is worked out in the following way.

Gamble A (0.4 x 20p) + (0.6 x 10p) = 8 + 6 = 14p

Gamble B (0.8 x 0p) + (0.2 x 70p) = 0 + 14 = 14p

In gamble A 0.4 is the probability of winning 20p and 0.6 is the probability of winning 10p.

Edwards (1955) pointed out that when making choices between bets a traditional normative theory claims that gamblers should choose the bet that has the highest EV or the lowest negative EV. Edwards (1955) however noted that people do not do this and said that it was doubtful whether they should do so in some cases. Wright (1984) claims that as the expected values are the same for each of the gambles then people should be indifferent and have no preference for one gamble over the other. However as Edwards (1955) found this was not the case and two thirds of his participants showed preferences between gambles with equivalent expected values, with most preferring gambles that had long shots of winning a large amount as long as there was little or no chance of losing very much. Wright (1984) suggests that these expected values or probabilities can be either subjective (as they are assessments or judgements particular to a person) or objective (such as in the toss of a coin) and in either case they will vary from person to person. This suggests that performance on such tasks would reflect individual differences in attitudes to risk.

Yates & Stone (1992a) suggest that risk seeking behaviour is accompanied “by a preference for an uncertain prospect over a sure thing equivalent to the expected value of the prospect” (p12). Preference for the sure thing is referred to as risk averse behaviour whereas preference for the uncertain prospect is risk seeking behaviour. Neumann & Politser (1992) note that early studies of decision making and probability in the presence of risk were originally developed to help gamblers improve their chance of winning. They claim that:

> "seventeenth century mathematicians assumed that gambles were evaluated on the basis of their expected values, reasoning that this approach followed from the law of large numbers (i.e. that in repeatedly played gambles, the long run average payoff converges to the expected value)".
>
> Neumann & Politser (1992, p31).

However as Neumann & Politser (1992) point out, the 18^{th} century Russian mathematician Nicholas Bernoulli noted from his "St Petersburg Paradox" that people do not evaluate gambles only on their expected values. His cousin Daniel Bernoulli (1738; cited in Neumann & Politser, 1992) had hypothesised that people value gambles based on the expected utility associated with the outcomes of the gambles and not the expected value of the gambles. Neumann & Politser (1992) define expected utility as what you would expect to win. Edwards (1955) defines expected utility as the <u>subjective value</u> of the *i*th outcome of the bet. Whereas an expected value is the <u>probability</u> of the *i*th outcome of the bet. Edwards (1955) notes that an expected utility theory is about what people actually do rather than about what they should do, as in expected value theory.

Baron & Fisch (1994) defined subjective probabilities as a theoretical entity that is inferred from a person's choice. Baron & Fisch refer to this as the 'behaviourist interpretation' of subjective probabilities as they are defined in terms of choices and inferred from the choices people make. The alternative to the 'behaviourist interpretation' that they suggest is to ask people about the choices they make. According to this the Bets paradigm, which gives people a choice between alternatives with equivalent expected values provides an objective measure of subjective probability.

Neumann & Politser (1992) give an example of Nicholas Bernoulli's famous "St Petersburg Paradox". In their example they say that if you were to toss a coin until you got the head side and the person would win a value of $\$2^n$ (where n is the number of times that you would need to toss the coin to get a head). When the person playing was asked how much they would pay to play this gamble, Bernoulli noted that most would pay very little. What they would be prepared to pay would be less than the expected value of the gamble. The expected value of the first toss of the coin is (0.5 x \$2) = \$1. Where 0.5 (or ½) is the probability of tossing a head and \$2 is the amount to be won. On each successive toss of the coin the expected value would be the same i.e. \$1. According to this theory a person should make choices based on the expected utility where utility represents an individual's preference over outcomes and the expected utility theory assumes that an individual will consistently choose the alternative that has the highest expected utility. In expected utility theory there is also the factor of how many times the coin would need to be tossed to produce the desired outcome or in Neuwman & Polister's example to win the $2. If the gamble is repeatedly played then the long run average payoff converges to the expected utility, however in real life most gambles are not played repeatedly.

The Bets test had previously been piloted by Montgomery (Personal Communication,1997) who first used a 10 item version of Bets-16. From the 10 item version Montgomery then developed the current 16 item version. The remaining six items were developed to reflect gambles that were similar to the ones within the 10 item version that best discriminated between participants (i.e. for some bet pairs almost everyone made the same choice for others there was more variability). The original 10 item version is contained within the current 16 item version of the Bets-16 and forms the first 10 items. Montgomery found low but significant correlations between Bets-16 and the TPQ novelty seeking scale (rho = 0.15, n = 163, p=0.05), and between The Sensation Seeking Scale (Zuckerman, 1984) (rho=0.19, n=121, p=0.03) and between Bets-16 and the Experience Seeking subscale of The Sensation Seeking Scale (rho = 0.23, n=121, p=0.01). No significant correlations were found between Bets-16 and either of the I-7 scales. These correlations reported by Montgomery further demonstrates the low correlations between self-report questionnaires and objective tests that are measuring aspects of impulsivity.

As mean scores, reliability and validity had not been established for the Bets-16 test, the series of studies in this chapter were carried out to

(i) establish mean scores for males and females on the Bets-16, (ii)investigate test-retest reliability,(iii) internal consistency, (iv) convergent validity, and (v) whether there were any differences between males and females on the risk-taking measure. It also aimed to investigate whether there was an effect of age on the Bets-16 as it has been generally assumed that conservativeness increases with age and Eysenck & Eysenck (1991) found that scores on their risk-taking measure venturesomeness and impulsiveness decreased with age.

4.1 Normative data and reliability of Bets-16.

As noted previously although Montgomery had piloted the Bets-16 reliability and validity had not been assessed, or mean scores established. The first study undertaken was to establish the mean scores for males and females, investigate whether were any sex differences on the Bets-16, investigate the test-retest reliability and internal consistency.

4.1.1 Method.

Participants.

Two groups of participants were recruited to obtain normative data and as part of a test retest. At time one a total of 160 participants were recruited and these consisted of two different groups. Group 1 participants were 104 first year psychology students, 25 males (age 20.4 ± 3.06) and 79 females (age 23.27 ± 6.8). At time two 60 (of the original 104) participants were recruited again (46 females and 14 males), this equates to 57.7% of participants from time 1. Participants in group 2 were 56 second year undergraduate psychology students and consisted of 44 females (age 26.11 ± 7.57) and 11 males (age 28.8 ± 7.9). At time two 38 of the participants were recruited again (29 females and 9 males). Recruitment of group two at time 2 equated to 67.9% of the original group 2 sample.

Materials.

The Bets-16 is a simulated betting task, consisting of 16 pairs of hypothetical bets that make up the Bets-16 task. There are five pages of A4 (210 X 297 mm) paper to the task, only one side of the paper is printed on. The first page consists of instructions and a practice bet. There are four pairs of bets on each of the next four pages. Each pair of bets is separated from the next one by a black solid horizontal line across the page. Each pair of bets consists of two pie charts that have different values assigned to each portion of the pie (see figure 4.1.2). The pairs of bets are numbered from 1-16 and within each pair the two choices are labelled A and B. One option (either A or B) within each pair is what is considered a risky bet (the long shot) and the other option is a safe or risk averse bet (the sure thing). The safe bet within each pair is the option where there is a guaranteed win of one of two relatively small amounts of money (A in figure 4.1.2). The risky bet is the option within each pair that involves a large chance of winning nothing and small chance of winning a larger amount. The position of the safe bet (A or B) was randomly varied. The expected values for each member of a pair are identical. For example, in figure 4.1.2 the expected value in each bet within the pair is £54. In this example Bet B represents the long shot or risky bet, and bet A represents the sure thing or risk averse choice. The long shot is considered to be the risky choice because it requires the rejection of a guaranteed win for the unlikely chance of a larger win.

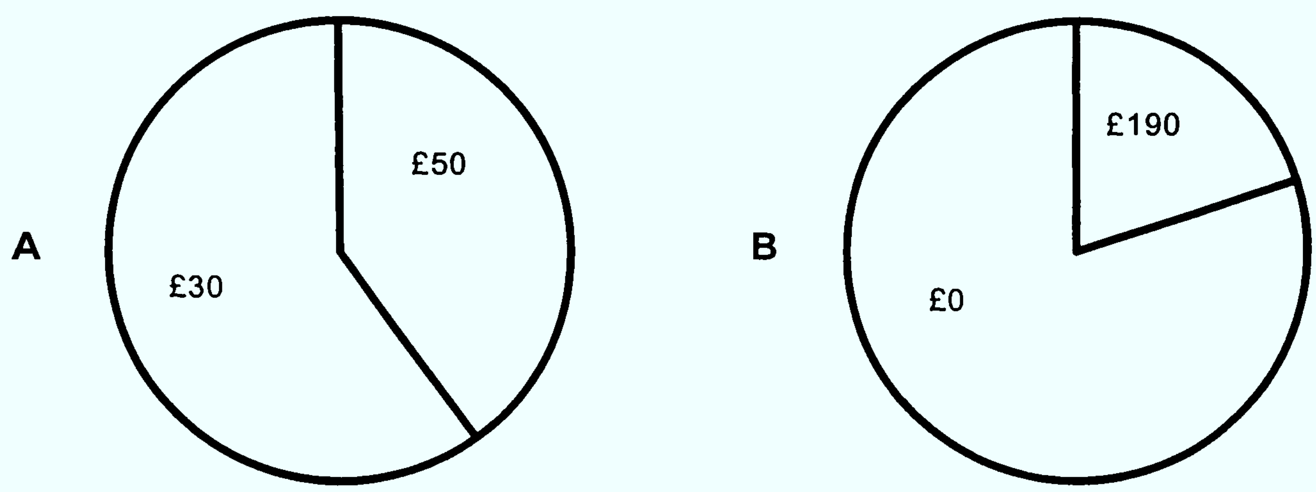

Figure 4.1.2. An example of a pair of bets contained within Bets-16 task.

Instructions to participants.

This test requires you to make choices between pairs of imaginary bets which are represented in a pie chart format (see next page). For each bet you should imagine there is a pointer in the centre of each circle. This imaginary pointer can be spun and you would win whatever amount is written in the section the pointer lands on. To make this clearer there is a practice trial at the bottom of this page. In this example if you choose Bet A there is a 50%, or 1 in 2, chance that you would win £10,000 and a 50% chance that you would win nothing (£0). Alternatively if you choose Bet B there is a 25%, or 1 in 4, chance that you would win £15,000 and a 75%, or 3 in 4, chance that you would win nothing (£0). On the following pages there are sixteen more pairs of bets, all you have to do is choose which bet from each pair YOU would rather take. Please circle either A or B to indicate which bet is YOUR choice. You will notice that for each pair of bets one choice offers a certain win, but the other choice offers the possibility that you will make either a bigger win or win nothing (£0). There are no right or wrong answers, we are only interested in your personal preference. Please try to answer as if you were making a choice between real bets.

Remember, for each pair of bets circle either A or B to indicate which you prefer. Thank you.

Scoring:

The number of risky bets (choices of the long shot) that an individual chooses is added up generating a score between 0 and 16. A risky choice from each pair is the member of that pair that involves the large chance of winning nothing (option A in figure 4.1.2) and a small chance of winning a larger amount. The other option in the pair is considered risk averse and this is the option within each pair that involves a definite win of one of two smaller amounts (B in figure 4.1.2). Higher scores represent more risk-taking behaviour.

Procedure.

At test time 1 participants in both groups (1 and 2) were recruited in small group sessions of approximately 10 per session. They were given the Bets-16 task and instructed how to generate a code to put on the consent form, they were instructed that they would be asked for this code at the retest session. For both groups re-testing at time 2 took place in a large group setting prior to the commencement of a lecture. Participants were reminded of how they generated the code at time one, and were instructed to put this code on the consent form and sign the consent form if they wished to take part. Participants who did not take at time one were also invited to take part as it would useful for mean scores. Participants were instructed not to confer with their neighbour and to work independently. No one appeared to be conferring with their neighbour and as many of the people present had completed the task at time 1 they were familiar with the instructions and completed it in approximately 5 minutes. Participants were debriefed as to the nature of the task after testing at time two.

4.1.2 Results.

Test for normal distribution showed that the bets data do not follow a normal distribution (Kolmogorov-Smirnov, $p < 0.001$) therefore non-parametric tests were used to assess whether there were any differences in the number of risky bets chosen between males and females. Table 4.1.1 shows the mean scores for males and females. These are the data from time 1 of the bets test-retest from both groups. There were no differences in the number of risky bets chosen between males and females ($U = 2131.50$, $N = 160$, $p > 0.05$, two-tailed test). Overall people preferred the safe bet, the sure thing.

Table 4.1.1 Mean and standard deviation scores for number of risky bets, for females and males for groups 1 and 2 collapsed together. N =160

	N	Mean	Std Deviation
Males	37	4.92	4.34
Females	123	4.55	4.41
Total	160	4.64	4.39

As there were no sex differences in the number of risky bets chosen the data for test retest reliability were pooled across sex and males and females analysed together. Reliability of the Bets-16 paradigm was examined by test retest correlation coefficients. The two groups were re-tested at different time intervals with group 1 being 10-11 weeks later and group 2 7-8 weeks later. Due to the different test-retest time periods test re-test correlation coefficients were calculated for each group separately. Table 4.1.2 presents the test retest coefficients for each group. The total mean number of risky bets chosen for the ninety eight participants (males and females) from time 2 was 4.33 (SD 4.54) which is comparable with the score of 4.64 (SD 4.39) from the 160 participants at time 1.

Table 4.1.2. Test retest correlation coefficients for Bets-16 for each group.

Group	N	Rho
1	60	0.66 **
2	38	0.63 **
Total	98	0.66 **

** Significant at $p < 0.01$ two tailed test.

As can be seen from table 4.1.2 the test retest coefficients were similar for the two different time periods of re-testing. Although the test re-test coefficients are below the generally acceptable level of 0.8, they are however moderate and significant.

Following the test retest for reliability, internal consistency of the Bets-16 was investigated. Table 4.1.3 presents the internal consistency (reliability) for the Bets-16 scale for each of the groups at each time period.

Table 4.1.3. Cronbach's alpha for internal consistency for Bets-16, by group and test session.

Group	N	Test (time 1)	N	Retest (time 2)
1	104	0.84	60	0.92
2	56	0.89	38	0.91
Total	160	0.86	98	0.91

Internal consistency (reliability) was investigated using Cronbach's alpha. This was first computed for each time and for each group separately. As can be seen from table 4.1.3 the coefficients were similar for both groups and as they did not differ between groups the data were pooled across the two groups to give a total score for internal reliability at each testing time. The Bets-16 shows good internal reliability.

As shown in table 4.1.1 the mean number of risky bets chosen was 4.64. As people were being risk averse and choosing the sure thing, or the safe bet, the frequency with which the risky bet was chosen for each of the 16 pairs of bets were examined. Frequencies of choice for the sure thing and the risky bet within each pair are presented in table 4.1.3.

Table 4.1.3. Percentages of participants who chose the risky bet or the safe bet in each pair and the expected values. N = 160

	Bet Pair Number							
	1	2	3	4	5	6	7	8
Safe Bet	80.6	62.5	84.4	67.5	58.1	75.6	75.6	74.4
Risky Bet	19.4	37.5	15.6	32.5	41.9	24.4	24.4	25.6
EV	£67	£16	£90	£24	£54	£8	£38	£320

	Bet Pair Number							
	9	10	11	12	13	14	15	16
Safe Bet	86.9	87.5	55.6	56.9	83.1	62.5	60.0	71.3
Risky Bet	13.1	12.5	44.4	43.1	16.9	37.5	40.0	28.8
EV	£240	£940	£14	£12	£54	£13	£26	£28

EV = expected value for each member of the pair of bets.

The risky bets that were most frequently chosen were number 5 by 41.9%, number 11 by 44.4%, number 12 by 43.1% and number 15 by 40% of participants. The expected values for each pair ranged from £8 to £940. There was a significant negative correlation between the expected values and the percentage of risky bets chosen (rho = -0.68, n = 16, p = 0.004). Therefore on the pairs of bets with low expected values more participants chose the risky bet than on pairs of bets with high expected values.

4.1.3. Discussion.

The studies in the current section established mean scores for males and females. There were no significant differences between males and females on the number of risky choices that they made. Both males and females were typically risk averse and usually chose the safe bet, with a guaranteed win, over the long shot bet where there was a smaller chance of winning a larger amount and a large chance of winning nothing. Edwards (1955) had reported that participants claimed that when there was no chance of losing anything then they preferred the long shot of winning a reasonable amount. This however was not the case in experiment 4.1, where people generally chose the safe bet and did not show a preference for the long shot of winning a reasonable amount.

The test retest reliability was similar with intervals of 7-8 weeks and of 11-12 weeks and in both cases the coefficients were moderate and significant. Furthermore the bets showed excellent internal reliability. There appeared to be a pattern with choice of the risky bet, with more participants choosing the risky bet on pairs with low expected values than on pairs with high expected values. This may be due to the pairs with low expected values having smaller amounts to win on the safe bet than pairs with high expected values. Consequently the cost associated with rejecting the sure thing is relatively low. Therefore participants may have considered this to be less of a gamble or risk as there was less to potentially lose, or not win. Some participants commented that as there was nothing to lose, i.e. the bets does not include an option where you lose an amount of money, they felt that it was better to take the chance of winning a larger amount, even if there was a large chance of winning nothing. Edwards (1955) had found that when there was any probability of losing then people avoided those gambles and suggested that people choose bets so as to maximise subjectively expected utility. Based on the findings of Edwards (1955) and the comments made by some of the participants in the current study it was decided to develop a second version of the Bets which incorporated a loss element.

4.2 Development of the Bets-17.

4.2.0 Introduction

Following feed back from the previous experiment to test the reliability of the Bets-16 and to establish normative data it was decided to incorporate a loss element into the bets paradigm. Some participants had mentioned that as there was nothing to lose in Bets-16 you may as well go for the long shot of winning a large amount. However despite this people still made safe choices and were generally risk averse. Therefore due to feedback from experiment 4.1 twenty new pairs of bets (see footnote 1 page 120) were developed with a loss element. The aims of the current study were to (i) establish mean scores for males and females on Bets-17 (ii) to investigate whether there were any sex differences on the risky choices made on Bets-17 (iii) to investigate the internal consistency of Bets-17 and (iv) to investigate the correlation between Bets-16 and Bets-17.

4.2.1 Method

Participants

One hundred and eighty two undergraduate psychology students took part. Participants were 151 females aged 18-47 (mean 23.37 ± 6.80) and 31 males aged 18-49 (mean 24.03 ± 7.77). Females made up 83.0% of participants and males 17.0%.

Materials

Bets-16

Bets-17.
Bets-17 is a simulated financial risk-taking task. Bets-17 was comprised of twenty pairs of bets, each option within each pair (like Bets-16) has the same expected values (EV). The expected values ranged from £4 for Bets 17, 18 and 20 to £65 for bet 3. Each pair of bets included a choice that involved either a probable loss or a less probable win, see bet B in figure 4.2.1. One of the choices (either A or B) in each pair had the loss element to it, with there being a large chance of a loss and a small chance of winning a larger amount. The other option of the pair was either a choice that gave a definite win of a small amount as in Bets-16 (the sure thing) or involved a large chance of winning nothing against a small chance of winning a larger amount (longshot). Figure 4.2.1 shows an example of a pair of bets from the long shot scale.

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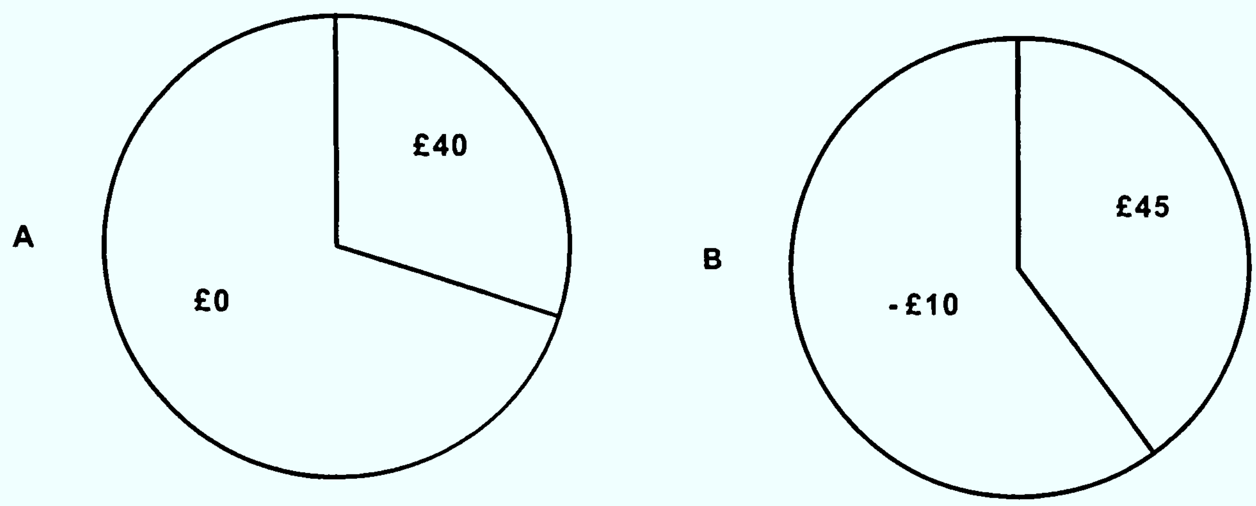

Figure 4.2.1. An example of a pair of bets from Bets-17 long shot scale.

The position of the safe bet, either A or B, was randomly varied and appeared equally in A and B. Figure 4.2.1 gives an example of long shot versus possible loss. Bet A is the safe bet (long shot) and Bet B is the risky bet. This is an example from the long shot scale and Bet A is considered the safe bet (risk averse) as there is no loss element to this option, rather it involves a large chance of winning nothing and a smaller chance of winning £40. Whist bet B is considered the risky choice as there is a large chance of losing £10 against a long shot of winning £45.

Figure 4.2.2 shows an example of one of the pairs of bets from the second scale of Bets-17, the surething.

8.

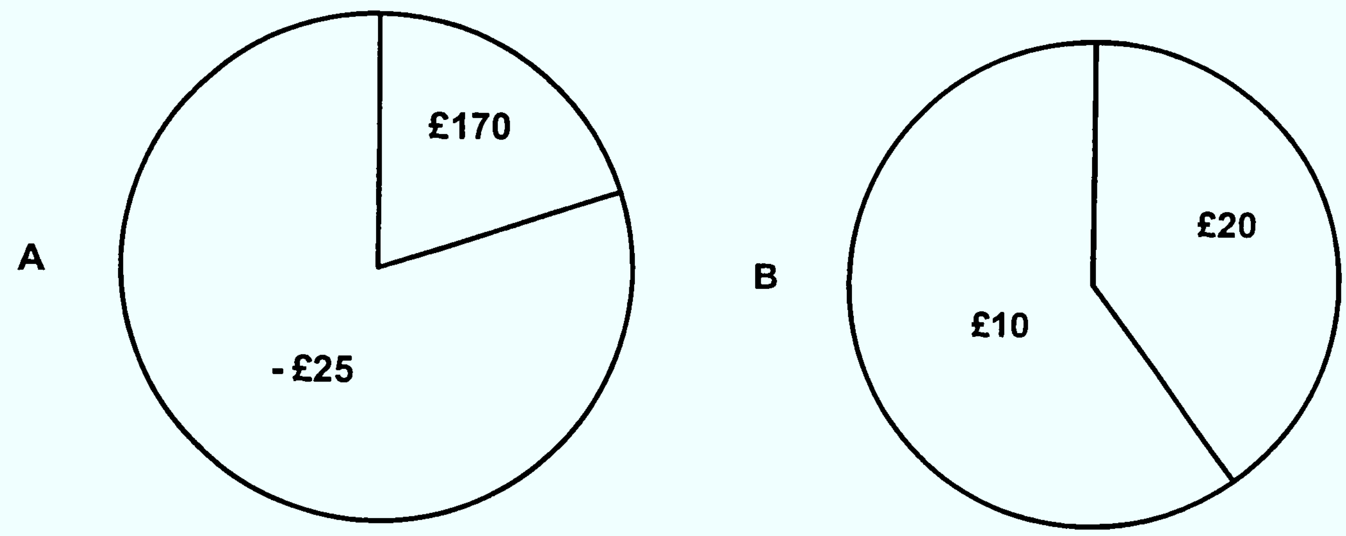

Figure 4.2.2. An example of a pair of bets from the sure thing scale of Bets-17.

In the sure thing scale, represented in figure 4.2.2, the alternative to a possible loss is a guaranteed win of one of two small amounts. Again the option in the pair that involves the loss element (A in figure 4.2.2) is the risky choice and option B which involves a guaranteed win is the safe bet and constitutes a risk averse choice.

Scoring.

As in Bets-16 the number of risky bets that an individual chooses is counted. There are two scores generated in the Bets-17 as the number of risky bets chosen on the 7 pairs where there is a definite win are counted (sure thing scale) and then the number of risky bets chosen on the 10 pairs where there is a long shot of winning are counted to give the second score (long shot scale). A score between 0-7 is generated for each participant for the sure thing scale and for the long shot scale a score of 0-10. There is a total scale score of 0-17. Low scores indicate risk averse behaviour and high scores indicate risk-taking behaviour. For both scales the risky choice is the bet offering a possible monetary loss.

Procedure.

The data were collected at different time periods. Most of the participants were seen in small group situations of approximately 8-10 and others were seen on a one to one basis. The instructions for Bets-17 and Bets-16 were explained, either with the group or the individual. It was emphasised that participants choose either A or B for each pair and indicate their choice by circling either A or B. Participants took approximately 5-10 minutes to complete the Bets-17 and the same amount of time to complete Bets-16.

4.2.2 Results and discussion.

Overall participants tended to be risk averse and chose the safe bet. The risky bets were chosen by a minority of the participants. Percentages were computed to explore on which pairs the risky bets were frequently chosen. These are shown in table 4.2.1 for the sure thing scale. The expected value of each pair are also given in table 4.2.1.

Table 4.2.1. Percentages of participants who chose the risky bet and safe bet for each pair of bets on the sure thing scale and the expected value of each option within a pair of bets. N = 182

	Bets-17 sure thing item number						
	1	4	6	8	12	14	15
Safe Bet	67.6	79.1	83.0	72.5	81.3	74.2	69.2
Risky Bet	32.4	20.9	17.0	27.5	18.7	25.8	30.8
EV	£24	£48	£23	£14	£25	£32	£11

EV = expected value for each member of the pair.

As shown in table 4.2.1 expected values ranged from £11 to £48. A high proportion of participants chose the safe bet on each of the 7 pairs of bets in the sure thing scale, which involves a definite win. The risky bet was chosen most frequently on number 1 (EV £24) by 32.4% and on number 15 (EV £11) by 30.8% of participants. The correlation between expected value and the percentage of participants choosing the risky bet was negative but non-significant (rho = -0.36, n =7, p = 0.43).

Table 4.2.2 presents the percentages of participants who chose the safe bet and the risky bet on the other Bets-17 scale, the long shot scale, plus the expected values (EV) of each pair.

Table 4.2.2. Percentages of participants who chose the safe bet and the risky bet from each pair of the long shot scale of the Bets-17, and the expected value of each option within a pair of bets. N = 182

	Bets-17 long shot item number									
	2	3	5	7	9	11	17	18	19	20
Safe bet	73.6	75.3	81.9	77.5	74.7	86.8	56.0	81.3	84.6	68.1
Risky bet	26.4	24.7	18.1	22.5	25.3	13.2	44.0	18.7	15.4	31.9
EV	£27	£65	£48	£30	£12	£36	£4	£4	£7.5	£4

As shown in table 4.2.2 expected values for the long shot scale ranged from £4 to £65. On the long shot scale the risky bets that were most often chosen were from pair number 17 (EV £4) by 44.0% of participants and number 20 (EV £4) by 31.9% of participants. The correlation between expected value and the percentage of risky bets chosen on the long shot scale was negative but not significant (rho = -0.44, n = 10, p = 0.21).

From the 182 participants mean scores were computed for each of the Bets-17 scales and total scale according to sex. These are presented in table 4.2.3.

Table 4.2.3. Means (and standard deviations) for the number of risky bets chosen and the minimum and maximum score obtained for each of the Bets-17 scales.

	sure thing		long shot		total score	
	mean	min-max	mean	min-max	mean	min-max
males	1.90	0-6	2.58	0-7	4.48	0-13
n = 31	(1.92)		(2.13)		(3.45)	
females	1.70	0-7	2.36	0-10	4.06	0-14
n = 151	(1.91)		(2.40)		(3.68)	
total	1.73	0-7	2.40	0-10	4.13	0-14
n = 182	(1.91)		(2.35)		(3.63)	

Although males had a tendency to score slightly higher than females on both of the subscales and on the total scale of the Bets-17, these differences between males and females were not significant. Long shot scale (U = 2106.50, N = 182, p = 0.37), sure thing scale (U = 2150.00, n = 182, p = 0.46) and for the total scale (U = 2142.00, n = 182, p = 0.45).

There is no evidence to suggest that the number of risky choices varies between the long shot scale and the sure thing scale, however there are different numbers of items in each of the subscales of the Bets-17. As there were no differences in scores between males and females, the data from males and females were pooled together and then the proportion of risky responses made by participants was calculated so as to enable a comparison between the two scales. A proportion score was obtained by dividing the mean score by the number of items within each scale to give a total score of 0.25 per item for the sure thing scale, 0.24 for the long shot scale and 0.24 for the total score. Thus on the basis of the proportion of risky responses made there is no difference between the two scales.

The final aim of this study was to investigate the internal consistency of bets-17. Internal consistency of the scales were investigated by Cronbach's alpha and the coefficients are presented in table 4.2.4

Table 4.2.4. Internal consistency for each scale of the Bets-17 and the total scale. N = 182

Scale	cronbach's alpha	items
long shot scale	0.76	10
sure thing	0.75	7
total scale	0.82	17

Internal consistency of the two subscales and total scale of the Bets-17 were computed using Cronbach's alpha. The Bets-17 scales shows acceptable internal consistency although it is lower than that of Bets-16.

<u>Correlations between Bets-16 and Bets-17.</u>

Of the 182 participants who participated to give normative data for the Bets-17 129 of these also completed the Bets-16. There were 105 females (81.4%) aged 18-47 (mean 23.24 ± 6.88) and 24 males (18.6%) aged 18-49 (mean 25.13 ± 8.50). Although the mean age of the males was older than females it was not significantly different ($t = -1.16$, $df = 127$, $p = 0.25$, two tailed).

Table 4.2.5 presents the mean scores, and standard deviations for the Bets-16 and Bets-17 from the 129 participants who completed both versions of the bets.

Table 4.2.5. Mean and standard deviation scores for males and females on Bets-16 and Bets-17 scales. N =129.

	sex					
	female n=105		male n=24		total n=129	
scale	Mean	s.d	Mean	s.d	mean	s.d
Bets-16	4.61	5.28	5.21	4.03	4.72	5.06
Bets-17 longshot	2.08	2.07	2.58	2.00	2.17	2.06
Bets-17 surething	1.76	2.01	2.08	1.84	1.82	1.92
Bets-17 total	3.80	3.60	4.67	3.32	3.96	3.56

As seen in table 4.2.5 males had a tendency to be more risk taking all the Bets scales, however there were no significant differences between males and females on either scale (all $p > 0.05$). The mean scores on Bets-16 are comparable with those obtained in experiment 4.1.

Table 4.2.6 presents correlations between the two versions of Bets, Bets-16 and Bets-17.

Table 4.2.6. Spearman correlation coefficients between Bets-16 and Bets-17 scales on the number of risky bets chosen. N = 129.

	Bets long shot	Bets sure thing	Bets-17 Total
Bets-16 paradigm	0.29 **	0.57 **	0.49 **
Bets-17 total	0.87 **	0.89 **	
Bets sure thing	0.64 **		

** Significant at the p< 0.01 level (2 tailed).

As can be seen in table 4.2.6 all correlations between Bets-16 and the three scales of Bets-17 were positive and significant. The coefficients between Bets-16 and Bets-17 were low to modest whereas the coefficients between the two scales of the Bets-17 and the total scale were modest-high.

The Bets-17 showed similar results to Bets-16, in that risk-taking behaviour was not different between males and females, and people were risk averse, tending to prefer the safe bets. The mean number of risky bets chosen on Bets-17 was slightly lower than that of Bets-16, but comparable. The Bets-17 also showed adequate internal consistency. As it was not possible to administer the Bets-17 a second time to the population in this study, to assess test retest reliability, a later study was carried out to address this issue.

4.3. Test retest reliability of Bets-17.

Although mean scores for males and females had been established, and the internal reliability of the Bets-17 investigated, reliability over time had not been established. The present study was conducted to investigate reliability of the Bets-17 using a test retest paradigm.

4.3.1 Method

Participants

At time 1 there were 90 participants, 74 females aged 18-47 (mean 22.34 ± 6.35) and 16 males aged 18-42 (mean 24.19 ± 8.04). Females made up 82.2% of participants and males 17.8%. At time 2 there were 46 participants, which is 50.5% of the population recruited at time 1. Of the 46 participants at time 2 there were 40 females aged 18-44 (mean 22.80 ± 6.52) and 6 males aged 18-35 (mean 22.67 ± 6.41). At time 2 females accounted for 87% of the sample and males for 13% of the sample.

Materials

Bets-17. See above.

Procedure

At time one participants were approached in small group sessions and invited to take part in a study to establish reliability of the Bets-17 task. They were instructed that they would be given the task again in a few weeks time and therefore a code was required which would be memorable for them. Participants were instructed how to generate the code and to put the code in the space provided on the consent form. They were informed that they would be asked for this code again at the retest. Participants were instructed to work independently as it was their choice I was interested in. They were also instructed to read the instructions and to circle either A or B in each pair. Data at time 2 was also collected in small group sessions. Participants received research participation credit for taking part at each time period. The Bets-17 took approximately 5-10 minutes to complete at each time period, and participants were debriefed as to the nature of the task after time two data had been collected.

4.3.2. Results and discussion.

There were no significant differences in age between males and females either at time 1 ($t = -1.00$, $df=88$, $p=0.32$) or time 2 ($t = 0.047$, $df=44$, $p=0.96$). As there were no significant differences in age between males and females the data from both was combined to investigate test-retest reliability. Mean scores for the number of risky bets chosen by males and females on the Bets-17 scales for each time period are given in table 4.3.1.

Table 4.3.1. Mean and standard deviation scores for the number of risky bets chosen on the Bets-17 scales for times 1 and 2.

	Time 1	n =90	Time 2	n =46
	mean	s.d	mean	s.d
Longshot	2.34	2.20	2.07	2.43
Surething	1.77	1.98	1.26	1.82
Total	4.08	3.68	3.35	3.70

As can be seen from table 4.3.1 the mean number of risky bets chosen on each scale of the Bets-17 decreased from time one to time two. There was however a smaller sample size at time two. There were no significant differences between the number of risky bets chosen by participants at time one and time two for the longshot scale ($Z = -0.60$, $n = 46$, $p = 0.55$), the surething scale ($Z = -0.89$, $n = 46$, $p = 0.37$) or for the total scale ($Z = -0.89$, $n = 46$, $p = 0.37$).

The interval between test and retest was 7-8 weeks. Non-parametric correlation coefficients were calculated to assess the test retest reliability and the test retest coefficients are given below in table 4.3.2.

Table 4.3.2 Test retest coefficients for the Bets-17 scales. n =46.

Long shot scale	Sure thing	Total scale
0.65 **	0.73 **	0.80 **

**Significant at $p < 0.01$ (2-tailed).

The test retest correlation coefficients were all significant and moderate to high. The lowest correlation coefficient of 0.65 was modest and accounts for 42% of the variance. Thus the Bets-17 shows acceptable stability over time despite the fact that it is measuring financial risk-taking behaviour and a person's choice could be influenced by their financial situation which could change from test to retest. The bets-17 demonstrates better test retest reliability than the bets-16, with the same time interval between test and retest. Thus the bets-17 may appear more stable over time than the bets-16 as aversion to actual loss may be more stable than aversion to relative loss as measured by Bets-16.

4.4 Experiment 4. Assessment of convergent validity of the Bets test.

4.4.0. Introduction

The final study in this chapter was carried out to investigate the correspondence of the Bets-16 and Bets-17 with another risk-taking measure. A potentially older population were also sought to be recruited to investigate possible age effects on the Bets paradigm. The other measure of risk-taking chosen was a self-report measure, The Everyday Risk Inventory-ERI (Steketee and Frost, 1994). Steketee & Frost noted that there was a lack of adequate measures of risk-taking and in 1994 they pointed out that the two validated measures of risk-taking behaviour, The Sensation Seeking Scale (Zuckerman, 1984) and the Risk-taking scale from the Jackson Personality Inventory (1976) reflected activities of pleasure seeking. The ERI was selected as it had been developed by Steketee & Frost to assess everyday risk-taking which focused on potentially harmful ordinary activities, unlike Zuckerman's Sensation seeking scale (SSS) and Jackson's risk-taking scale which focuses on activities of pleasure seeking. The ERI measures the avoidance of danger and harm and therefore was considered to be a measure which also assessed risk-taking behaviour and risk averse behaviour. Steketee & Frost reported significant ERI correlations with the Zuckerman Sensation Seeking Scales of Thrill and Adventure Seeking (0.43) and Disinhibition (0.72).

4.4.1 Method

Participants

Seventy-eight people attending a psychology course on an Open University residential week were recruited. These consisted of 65 females aged 22-68 (mean 36.6 ± 9.6) and 9 males aged 21-45 (mean 36.7 ± 8.6). Data for both sex and age were missing for 2 participants, sex only was missing for 2 other participants and data on age was missing for a further 1 participant. Therefore the sex of four participants was unknown. There were no significant differences in age between males and females ($t\ (71) = -0.02,\ p>0.05$).

Materials.

Bets-16. (see 4.1)

Bets-17 (see 4.2)

Everyday Risk Inventory – ERI. Steketee & Frost (1994). Is a 32 item questionnaire (see appendix III). Participants rated on a five point Likert scale how likely they are to engage in behaviours that involve some degree of risk, from 'I would never do this' to 'I would definitely do this'.

Items are scored from 1-5. Good internal consistency (Cronbach alpha 0.91) and 14-21 day test retest reliability (0.93) were reported. Older participants and females showed greater risk avoidance. Scores range from 32-160 with lower scores indicating greater risk avoidance.

Procedure.

Questionnaire packs were given out which included the ERI questionnaire, the two Bets tests, Bets-16 and Bets-17, and an information sheet which asked for demographic information. Participants were requested to return the completed packs, sealed in the envelope provided, to a box when completed.

4.4.2 Results and discussion.

Mean scores for males and females on the Bets-16, Bets-17 and the ERI are given in table 4.4.1. The data from the four participants for whom category of sex was missing were excluded from the analysis. Therefore total N = 74.

Table 4.4.1. Mean and standard deviation scores for males and females on Bets-16, Bets-17 scales and the ERI.

	male n = 9		female n = 65		total n = 74	
	mean	SD	mean	SD	mean	SD
Bets-16	7.33	4.09	6.79	5.80	6.86	5.59
Longshot	2.11	1.90	1.11*	1.87	1.24	1.89
Surething	2.11	1.96	1.21[a]	1.97	1.32	1.98
Bets-17 total	4.22	3.46	2.32*	3.31	2.56	3.36
ERI	108.33	14.98	92.66**	16.88	94.57	17.35

* $p < 0.05$, ** $p < 0.01$, a $p = 0.054$ all comparisons between males and females.
Longshot and surething are the two scales from Bets-17. ERI = everyday risk inventory. Bets-16 data were missing for 2 females and Bets-17 data were missing for 3 females.

As can be seen in table 4.4.1 males had a tendency to score higher than females on all measures. The scores between males and females were significantly different for the ERI (t (72) = –2.64, $p< 0.01$), Bets-17 total score (U = 166.0, n = 71, p = 0.04), Bets-17 long shot (U = 174.0, n=71, p = 0.049). The difference between males and females for Bets-17 surething scale approached significance (U = 178.0, n =71, p = 0.054). There were no differences between males and females on the number of risky bets chosen on Bets-16 (U = 251.00,, N=72, p =0.58).

Correlation coefficients between the measures for females are presented in table 4.4.2. Correlations for males are reported in the text after table 4.4.2.

Table 4.4.2. Spearman correlation coefficients between Bets-16, Bets-17 longshot, surething and total scale, and the ERI for females only. N = 62.

	long shot	sure thing	Bets-17	ERI
Bets-16	0.26*	0.43**	0.35**	0.43**
Surething	0.68**		0.86**	0.09
Bets-17	0.93**	0.86**		0.09
ERI	0.05	0.09	0.09	

* $p < 0.05$, ** $p<0.001$. ERI = Everday Risk Inventory.

As shown in table 4.4.2, the correlations from the female data, Bets-16 showed significant positive correlations with the ERI, and the Bets-17 scales. The correlation coefficient between Bets-16 and the ERI was moderate and significant. The correlation coefficients between Bets-16 and the sure thing scale of Bets-17 were moderate and significant. The Bets-17 scales showed moderate to high correlations with each other, but did not show any significant correlations with the ERI. The only significant correlations with the male data were: Bets-17 total scale correlated with Bets-16 (rho = 0.69, n=9, p=0.4), Bets-17 longshot scale (rho=0.80, n =9, p=0.01), and Bets-17 surething scale (rho=0.94, n=9, p<0.001).

As the sample included a wider age range of participants than previous studies with either the Bets-16 or Bets-17 it was investigated whether age correlated with the measures. There were no significant correlations between age and any of the bets scales or with the Everday Risk Inventory (all p > 0.05).

The Bets-16 showed moderate convergent validity with a self-report measure of risk (the ERI), where the avoidance of risk is measured. The Bets-17 did not show convergent validity with the ERI. The group of participants included a wider age range than in previous studies using the bets, however there were no significant correlations between age and either of the bets tests. This study did show that males made significantly more risky bets than females on the Bets-17 but not on Bets-16. However the mean number of risky bets chosen on Bets-16 was higher for both males and females than in previous studies. One possible explanation for the higher mean scores on Bets-16 with the current sample could be that financially they are better off than the undergraduate students and this influences their attitudes to financial risk.

4.5 General Discussion.

Bets-16 showed high internal reliability and significant test retest correlation, with moderate coefficients. The moderate test retest coefficients could have been due to the long time period between test and retest, and as undergraduate students were used their financial situation may have changed from time 1 to time 2 and thus influenced their choice. Testing at time 2 was nearing the end of the academic term when students may be experiencing more debt and financial hardship. Without asking information about participants' current financial situation and whether this had any impact on their choices from time 1 to time 2, then this is merely speculative. There were however no differences in the mean number of risky bets chosen between times 1 and 2.

The majority of participants displayed risk averse behaviour and generally chose the safe bet across the 16 pairs of bets, with the average number of risky bets chosen being 4.6. There were no differences in financial risk-taking behaviour between males and females. There were certain pairs of bets in which the risky bet was frequently chosen, and this appeared to be when the amounts to won on the safe bet were small. This was supported by the negative correlation between the proportion of people who chose the risky bet and the expected value of the pair of bets. When the expected value was low then more people chose the longshot, or were risk takers, than when the expected values were high. The pairs of bets which elicited more risky choices seem to be those for which the safe bet option offers a relatively small win. Perhaps the reasoning behind the choice is that as you are not going to gain much on the sure thing, you may as well take a chance on winning a larger amount. Without information on why people made the choices that they did then this is only speculative.

Bets-17 also showed high internal consistency and good 7-8 week test retest correlation coefficients for the total scale. Test retest coefficients were moderate for the long shot scale and satisfactory for the sure thing scale. Internal consistency was lower for Bets-17 than Bets-16 but Bets-17 showed higher reliability over time. The better reliability over time of the Bets-17 cannot be due to differences in the test retest interval between the two versions, as one of the groups in Bets-16 also had an interval of 7-8 weeks. The Bets-17 may appear more stable over time than the Bets-16 as aversion to an actual loss, (as measured by Bets-17), is more stable than aversion to a relative loss as measured by Bets-16. Although both Bets-16 and Bets-17 are simulated financial risk taking tasks, the Bets-17 contains a loss element, whereas the loss involved in Bets-16 relates to the rejection of a sure thing in preference for an option which probably offers a win of nothing (the longshot).

The Bets-17 total mean score was slightly less than that of Bets-16 (4.13 vs 4.64). Where certain risky bets on Bets-17 were frequently chosen, with the exception of bet number 1, which had an expected value of £24, the others had low expected values ranging from £4 to £7. The correlations between expected value and the percentage of participants who chose the risky bet on the surething and the longshot scale, were being negative but not significant. Also on the longshot scale three of the pairs of bets had expected values of £4 and the proportion of participants who chose the risky bet in these three pairs of bets ranged from 44% to 18.7%. This demonstrates that there was more to the choice of a risky bet than the expected value of the bet.

On the Bets-17, as with Bets-16, males had a tendency to make more risky choices than females, but this was not statistically significant. The only differences between males and females on risk-taking behavior as assessed by the Bets was in experiment 4.4 where males made more risky choices on all scales of the Bets-17 than females. Both males and females in that group also made more risky bets on the Bets-17 and Bets-

16 than the participants in experiment 4.1. and 4.2. This may be due to the inclusion of a population who were older than that of undergraduates, however impulsivity and risk-taking behaviour is generally considered to decrease with age rather than increase. Rather than being age related, (there were no significant correlations in experiment 4.4 between age and any of the bets scales) the choice of more risky bets may reflect financial situation. People who are working generally have more disposable income than full-time students and therefore may be more inclined to take the risk of rejecting a small win for the possibility of winning a larger amount.

Bets-17 did not have high correlation coefficients with the Bets-16. This was seen in both experiments 4.2 and 4.4. Although the correlation coefficients were low they were significant. The correlation between Bets-16 and bets-17 long shot scale was only 0.29 which accounts for only 8% of the variance. The best correlation coefficients were 0.57 with the sure thing scale and 0.49 with the total scale.

Experiment 4.4 yielded a significant and moderate correlation between Bets-16 and the self report measure of risk, the Everyday Risk Inventory for females but not males. However the majority of the sample were female and there were only 9 males in the sample. None of the Bets-17 scales correlated significantly with the ERI for either males or females. These findings indicate that in terms of convergent validity Bets-16 is superior to Bets-17.

Literature suggests that laboratory simulations of gambling do not resemble actual gambling and it has been said that they lack external validity (Anderson & Brown, 1984). Breen & Zuckerman (1999) claim that in laboratory gambling simulations students, who have little or no experience of gambling, are used as participants and are given theoretical rather than real gambles in these situations. Breen & Zuckerman claim that this does not resemble gambling in a natural setting as behaviours such as 'chasing' which are common with gamblers do not exist in a laboratory simulation using theoretical gambles.

It has been suggested that 'chasing' behaviour in gambling is one of the defining symptoms of problem gamblers. 'Chasing' is when the gambler continues to gamble after a losing streak often with increasing amounts of money placed on each bet (Dickerson, 1993; cited in Breen & Zuckerman, 1999). Breen & Zuckerman (1999) used what they considered to be a more realistic laboratory gambling situation where the participants (students) gambled for real money in the laboratory. They found that those who were within session 'chasers' scored higher on impulsivity as assessed by the impulsivity factor of the Zuckerman-Kulhman Personality Questionnaire (ZKPQ).

However the Bets Task is not designed to assess gambling behaviour per se but rather it is a measure of financial risk-taking. Use of the Bets test with a gambling population would be needed to assess its validity as a measure of gambling. Also future studies could be carried out possibly incorporating questions about gambling or to include a stake that participants would hypothetically wager before each bet.

As with any simulated task what one would do in the real situation and how much this corresponds to real life behaviour is unknown. It is also important to recognise that tasks like the Bets test measures financial risk and risk-taking behaviour may be domain specific. However Bets-16 did show convergent validity with the ERI which provides an index of risk taking relating to harm avoidance rather than financial risk. Moreover Bets-16 does distinguish ecstasy users from non-drug users, with ecstasy users choosing more risky bets (see chapter 8), and drug use involves risk in domains other than finance.

Wright (1984) summarises the work on subjective expected utilities by stating that it does not predict peoples' choice decision between simple gambles. Factors that do influence peoples' choice between gambles include "the probabilities of winning and losing, the amounts to win and lose and their associated distributions" (p65). This appears to be the case in the Bets tests where people's choices were driven by the amount they would win or lose on that hypothetical spin of the pointer. In the Bets-16 the risky bets that were frequently chosen were those in which the amounts to be won on the safe bet were very small, ranging from £5-£30. The risky bets frequently chosen on the Bets-17 were also bets where the amount to be won on the safe bet in the surething scale was small and also the amount to be lost on the risky bet was small. This suggests that when there was a significant amount to be won on the safe bet then participants were risk averse. However when the amount to be won on the safe bet was relatively small, some participants went for the long shot of winning a larger amount.

Whilst participants were not given the information that the expected values for each bet were identical this may be more representative of real life risk-taking. As Lane & Cherek (2000) point out many laboratory based investigations into risk-taking have actually presented the participants with the outcome. They suggest that this may not reflect what actually happens in a risk-taking situation, namely that individuals do not usually have information to hand about the probabilities of the outcomes when they engage in dangerous risk-taking behaviour. What they are choosing between in the Bets-16 is whether they prefer the certainty of a sure thing or the risk of a long shot. For the two scales in Bets-17, the sure thing asks whether a person prefers the certainty of a sure win against a risk of losing something but a chance of gaining a larger amount. Whilst the long shot scale asks do you prefer the risk of losing something but the chance of gaining a larger amount against the risk of winning nothing or less probably of winning a larger amount. Therefore both scales offer the risk of losing money but the chance to win a large amount. It was the alternative choice that differs between the two scales.

It could be said that the Bets test is only measuring a narrow aspect of risk-taking (financial risk-taking) as it has been suggested that risk-taking behaviour is different in different domains. However Yates & Stone (1992) suggested that there are three aspects to risk-taking - loss, significance and uncertainty. The Bets tests have all three elements. As there is a choice so there is the potential for the less appealing outcome occurring, this is the loss. There would also be significance associated with a loss and as the Bets involves a choice there is also uncertainty, albeit hypothetically in all three elements. However if the Bets test was actually played then all three elements would be present. Participants are instructed to make their choice as if they were playing real bets. As can be seen in chapter 8 the Bets-16 has distinguished ecstasy users from non-drug users, thus suggesting that the test is sensitive to differences in attitudes to risk.

Lane & Cherek (2000) suggest that current income and socio-economic status could have an effect on risk-taking behaviour. However they found that their two groups were similar, in that most were unemployed, yet the high risk group (mainly those with conduct disorder and past drug dependence) were more risk-taking in a laboratory task than the low risk group who did not meet the criteria for conduct disorder and/or drug dependence. Lane & Cherek results suggest that risk was therefore not related to income but rather related to other risky behaviours. In the current series of studies information was not obtained on either income or socio-economic status, but as the majority of participants were undergraduate students their income would be expected to be low and their financial position might well decline as the academic term progresses. For both the Bets-16 and Bets-17 testing at time 1 was at the start of the term and time 2 was nearing the end of the term. This may have had an influence on participants choice, although the number of risky bets was similar from time to time 2. However unless information is asked at the end as to whether their current financial situation influenced their choices on a simulated betting task then any conclusion is purely speculative.

Overall the two versions of the Bets test have good internal consistency and low-moderate reliability over time. Bets-16 has moderate and significant convergent validity with the self-report measure of risk-taking behaviour, the ERI. It furthermore demonstrates that correlations between self-report and objective measures are low but in this case significant. Mean scores have been established for males and females and these scores are reliably found with undergraduate students. The Bets-16 especially appears to be a reliable tool to measure the risk-taking aspect of impulsivity and was chosen over the Bets-17 to be included in the studies in this thesis as it showed better convergent validity than the Bets-17, and although the reliability was lower than for Bets-17 it was adequate.

Chapter Five

Pilot study and the relationship between impulsivity and smoking in an adolescent population

5.0 Introduction.

The studies in this chapter were conducted in order to (i) assess the suitability of the chosen objective and subjective measures for use with an adolescent population, (ii) obtain mean scores for the Bets-16 and 'Hungry Kevin' with an adolescent population, (iii) pilot the Walsh Test (iv) to assess the incidence of cigarette smoking and its relationship to impulsivity, and (v) investigate whether there are sex differences on the tasks and the incidence of smoking.

The pilot study had two phases: in the first phase the pencil and paper tasks (I-6, Bets-16 and a smoking questionnaire) were administered and in the second phase computer based tasks of impulsivity were administered.

5.1 Experiment 5.1 Adolescent Bets-16 data, and the relationship between smoking and impulsivity.

5.1.0 Introduction.

As mentioned in chapter 2, there have been links between smoking and impulsivity. However as Morgan (personal communication) suggests smoking related impulsive behaviour may be state dependent, rather than an enduring personality trait, which is consistent across time and situations (see chapter two).

A survey amongst secondary school children in England in 1996 reported that 11% of girls and 9% of boys aged 11-15 were regular smokers. Regular smokers were classified as those who smoked at least one cigarette per week (Jarvis, 1997). It was reported that when they start secondary school very few pupils are regular smokers, but by 13 years of age 6% of all pupils are regular smokers, 7% occasional smokers, 13% used to smoke, 23% have tried smoking, and 52% have never smoked. By the age of 14, these figures increase to 14% of all pupils are regular smokers with 27% having tried smoking and only 35% having never smoked. The prevalence of smoking continued to increase with age (Jarvis, 1997). At both 13 years and 14 years of age more females (7% & 16%) were regular smokers than males (4% & 13%) although the difference was not statistically significant.

These data suggest that young adolescents are still smoking cigarettes despite education programmes and the decline in cigarette advertising, and the prevalence of smoking increases with age. Smoking behaviour in itself, as well as having been linked with impulsive behaviour, suggests risk taking behaviour and failure to look ahead to the consequences of behaviour. Furthermore it has been reported that adolescents with ADHD are more likely to smoke than their age matched peers (Barkley et al, 1990; Milberger et al, 1997), further demonstrating impulsive and risk taking behaviour associated with smoking.

The present study investigated the relationship between smoking and impulsivity and, in doing so, piloted a smoking questionnaire and the Bets-16 test in an adolescent population. More specifically the current studies were carried out to assess the suitability of the chosen objective and subjective measures of impulsivity for use with an adolescent population. This was conducted in two stages, with the first experiment recruiting all year nine students from a secondary school to complete the Bets-16 test, the I-6 and a smoking questionnaire. The first study also served to obtain mean scores from an adolescent population on the bets-16. Whilst mean scores have been established for the self-report measure, the I-6, by Eysenck et al (1984), they were established over 15 years earlier.

In addition the relationship between these measures will be assessed. If impulsivity is treated as a multi-dimensional construct, then it should depend upon which aspect of impulsivity each particular test is assessing as to whether is any correspondence. Previous studies looking at the correlation between various measures of impulsivity have reported a low correlation between different measures (Gerbing et al, 1987; Parker, Bagby & Webster 1993).

The aims of the first experiment were (i) to pilot the Bets-16 and the smoking questionnaire with an adolescent population, (ii) to assess the relationship between Bets-16 and self-reported impulsiveness (ii) to assess the relationship between smoking and impulsivity and (iv) to assess whether are sex differences on Bets-16, impulsiveness or smoking.

5.1.1 Method

Participants

Eighty-eight year nine pupils, aged 13 and 14 years, were recruited from a local technical college in Kent to participate. Participants consisted of 33 females (37.5%) and 55 males (62.5%). Of the eighty-eight participants 27 (30.7% of the sample) failed to complete one or more measures. Data from these participants, with the exception of their smoking data, were excluded from the analysis. This left a total of 61 participants (69.3%) whose data were included in the analysis. These consisted of 36 males (59%) and 25 females (41%). Of the 27 who were excluded from the analysis, 23 failed to complete one or more tasks and 4 failed to complete the tasks as instructed.

The school, acting in its capacity as *in locus parentis,* gave prior permission for the pupils to be approached to participate. This had been given after consultation with the school's deputy principal with whom the measures had been discussion.

Materials

The I-6 (Eysenck et al 1984) is a junior version of the I-7 and is a 77-item questionnaire with three scales, Impulsiveness, Venturesomeness and Empathy. It is a forced choice questionnaire, where participants are required to answer yes or no to each of the 77 questions. Each scale consists of 23 items and the remaining 8 items do not form part of any scale. High scores reflect higher levels of impulsiveness, venturesomeness and empathy. No test retest coefficients are given for the I-6, but internal reliability data from Eysenck et al (1984) are presented in table 5.1. The mean age for the males in table 5.1.1 was 11.88 ± 1.96 years and for females was 12.60 ± 2.07 years.

Table 5.1.1 Internal reliability of the three I-6 scales for males and females. Adapted from Eysenck et al (1984).

	Impulsiveness	Venturesomeness	Empathy
Males	0.74	0.80	0.70
Females	0.78	0.81	0.69

As can be seen from table 5.1.1 the internal reliability of the I-6 is acceptable. Eysenck et al (1984) reported means and standard deviations for ages 8-15 years, from which it is apparent that scores on all 3 scales tend to increase with age. Table 5.1.2 presents mean scores for 13 and 14 year old males and females given by Eysenck et al (1984).

Table 5.1.2. Means (± standard deviations) for males and females for the three 1-6 scales Impulsiveness, Venturesomeness and Empathy. Adapted from Eysenck et al (1984).

	Males		Females	
	13yrs	14yrs	13yrs	14yrs
	n= 121	n = 89	n = 109	n = 232
Impulse	13.92 ± 4.52	14.34 ± 4.10	13.28 ± 5.18	13.84 ± 4.46
Vent	16.34 ± 4.16	17.11 ± 4.22	14.61 ± 4.47	14.73 ± 4.52
Empathy	14.49 ± 3.97	13.67 ± 3.96	17.53 ± 2.94	17.84 ± 3.43

Impulse = impulsiveness , vent=venturesomeness.

The Bets-16. Has been outlined in chapter 4. It consists of 16 pairs of hypothetical bets represented in pie chart format. Each pair contains one choice where there is a long shot of winning a large amount or a large chance of winning nothing, the other choice is a sure bet of winning one of two small amounts. Participants make a choice between the two bets in each pair. A point is scored for each choice of the long shot bet. This choice is considered risk seeking, whereas choice of the sure bet is considered risk averse. A score between 0-16 is obtained, with high scores indicating more risk-taking behaviour.

Smoking Questionnaire (unpublished). An eight item smoking questionnaire was designed for the current study to assess the smoking behaviour of adolescents. Only cigarette smoking is assessed by this questionnaire. Questions pertain to whether an individual smokes or not, and if they do smoke, additional questions about their weekly smoking behaviour and reasons for smoking are asked (see appendix V).

Procedure

On the day of the study participants were tested in two groups of approximately 44 per group. They were shown into the school gym, which had been set up for end of year examinations, by their form teacher and given a brief introduction by the deputy principal of the school. Following this, verbal instructions were given that they were to read the top sheet, which was an information sheet and consent form. It was explained that people who took part in research were required to sign such a form to show that they had agreed to take part. Their right to refuse to take part and to withdraw were explained. If they agreed to participate then they were to sign the consent form and proceed with the pencil and paper tasks. If they did not wish to participate then they were instructed to leave all of the papers blank. If they wished to complete the tasks but did not wish the information to be included in the study, then they should not sign the consent form and they could take their papers away with them at the end if they wished to. It was explained that failure to complete the consent form would mean that their information could not be included in the study. It was explained that no one from the school would see the completed forms or be given any of the information. This would remain confidential. They were told that the experimenter was interested in their smoking behaviour as the media suggested that smoking amongst adolescents, especially girls, was on the increase. They were to answer as honestly as possible and it was not suggested that smoking was either a good behaviour to be engaged in, nor was it suggested to be something that they should not do. The participants were then told to ask if there were any questions as they went along.

Besides reading the information sheet and consent form first, there was no specified order in which participants completed the tasks, this was left up to the individual participant. When the first group had completed the questionnaires, all questionnaires were collected up and the group were shown out of the room and the next group were shown in.

5.1.2 Results

From the original 88 participants, only 8 (9.1%) reported currently smoking on a regular basis, and 38 (43.2%) reported that they had tried it once or twice. Thirteen (14.8%) reported that they had previously smoked on a regular basis, but no longer do. The remaining 29 (33%) reported having never smoked, not even to try cigarettes once. This gives a total of 59 (67%) who had tried smoking at least once. Table 5.1.3 presents the percentages of males and females and their smoking behaviour.

Table 5.1.3 Smoking status by age and sex. N = 88

	Age			
	13		14	
	Sex			
smoking status	female n = 10	male n = 22	female n = 24	male n = 32
Never	3 (30%)	11 (50%)	4 (16.7%)	11 (34.4%)
Tried	3 (30%)	8 (36.4%)	10 (41.7%)	17 (53.1%)
Current	1 (10%)	1 (4.5%)	4 (16.7%)	2 (6.3%)
Ex-smoker	3 (30%)	2 (9.1%)	6 (25%)	2 (6.3%)
Total	10 (100%)	22 (100%)	24 (100%)	32 (100%)

As can be seen in table 5.1.3 a greater proportion of males than females had tried smoking and this increased with age. Overall 46.3% of males had tried smoking compared with 38.2% of females. However 14.7% of 13 & 14 year old females were current smokers compared with only 5.5% of 13 & 14 year males, and 26.4% of females were ex-smokers compared with 7.4% of males. Almost twice as many males had never tried smoking than females, 40.7% vs 20.6% respectively. There was a significant association between smoking status and sex, merging 13 and 14 year old females and 13 and 14 year old males to create one group of each sex (chi square =9.94, df=3, p=0.02).

The reasons given for having tried smoking were as follows: (i) to experiment by 25% (22) (ii) because friends smoked 20.5% (18), (iii) curiosity 3.4% (3), (iv) advertising 1.1% (1) and (v) 13.6% (12) did not give any reason.

Reasons for smoking given by those who currently smoke or did formerly smoke were: (i) habit 47.6% (10), (ii) because friends smoked, 23.8% (5), (iii) 4.8% (1) said he/she smoked because he/she enjoyed the sensation, (iv) 4.8% (1) said because it helped his/her concentration, (v) one other participant (4.8%) said because his mother smoked 20 per day and he wondered what it would be like and (vi) 14.3% (3) gave no reason. Seven participants gave more than one reason and they were categorised according to the first reason. This was usually habit and friends, or habit and the sensation smoking gives.

Impulsivity and smoking.

As can be seen in table 5.1.4, those who had tried smoking (males and females combined) had a tendency to score higher on impulsiveness than the other 3 groups. This difference between groups on impulsiveness was statistically significant ($F(3) = 3.82$, $p = 0.01$). Post hoc analysis showed that those who had tried smoking had significantly higher scores than those who had never smoked ($Tc = 3.66$, $p = 0.01$). No other between group differences on impulsiveness were statistically significant.

Means and standard deviations by smoking category for the I-6 scales and the number of risky bets chosen on Bets-16 are presented in table 5.1.4.

Table 5.1.4. Group means ± standard deviations, for the three I-6 scales and Bets-16 according to smoking status (males and females merged).

	N	I	V	E	Bets-16
Never	25	10.0 ± 4.3	14.6 ± 4.6	14.6 ± 5.0	2.3 ± 4.0
Tried	35	13.7 ± 4.3**	17.7 ± 3.6*	14.5 ± 3.9	3.7 ± 4.9
Current	8	13.3 ± 4.1	15.3 ± 4.1	15.4 ± 3.5	2.5 ± 2.3
Ex	11	13.3 ± 4.4	16.1 ± 4.1	16.4 ± 5.3	3.1 ± 5.4
Total	79	12.4 ± 4.5	16.3 ± 4.2	14.9 ± 4.4	3.1 ± 4.5

** p = 0.001, * p = 0.03 vs never smoked. I = impulsiveness, V = venturesomeness, E = empathy.

As can be seen in table 5.1.4 there was also a tendency for the tried smoking group to score higher on venturesomeness and this difference was statistically significant ($F(3) = 2.94$, $p = 0.04$). Again the only significant difference with post hoc tests was between the non-smokers and those who had tried smoking ($tc = 3.05$, $p = 0.03$).

There were no significant differences between groups on I-6 empathy ($F(3) = 0.54$, $p = 0.66$). Neither were there any significant differences between group on Bets-16 , number of risky bets chosen (chi-square (3) = 1.67, $p = 0.64$) although it is apparent from table 5.1.4 that the tried smoking group recorded the highest score on Bets-16.

Impulsivity and risk-taking by sex.

Due to insufficient numbers of males and females within each smoking category an analysis of smoking by sex on risk-taking and impulsiveness was not possible. However overall sex differences on risk-taking and impulsiveness were investigated. Scores obtained on the Bets-16 and I-6 scales are given in table 5.1.5 according to sex.

Table 5.1.5. The mean (and standard deviation) scores for males and females on the Bets-16 paradigm, and the three scales of the I-6.

	Females n = 25	Males n = 36
Impulsiveness	12.16 (4.41)	12.14 (5.10)
Venturesomeness	15.24 (4.66)	16.97 (3.71)
Empathy	17.40* (3.10)	13.64 (4.22)
Bets-16	3.04 (4.89)	3.33 (4.45)

* $p < 0.001$

As can be seen from table 5.1.5 the mean scores for males and females were similar for impulsiveness, but males scored slightly higher for venturesomeness. There were no statistically significant differences between males and females on the I-6 impulsiveness scale ($t\ (59) = 0.17$, $p > 0.05$, two-tailed), or the venturesomeness scale ($t\ (59) = -1.61$, $p > 0.05$, two tailed). Females scored significantly higher on the empathy scale than males ($t\ (59) = 3.80$, $p < 0.001$, two tailed).

The hypothetical Bets-16 paradigm, which was scored as the number of risky bets chosen out of the 16 pairs, did not show any difference between males and females. This was confirmed by analysis with non parametric Mann-Whitney test ($U = 393.0$, $N = 61$, $p > 0.05$).

Correlational analysis.

As the only significant difference between males and females was with I-6 empathy scores, correlations were computed separately for males and females for empathy. For females there were no significant correlations between empathy and either of the other I-6 scales or the Bets-16 (all $p>0.05$). The male data showed a significant Pearson correlation between empathy and venturesomeness ($R=0.56$, $n=36$, $p<0.001$). There were no significant correlations with empathy and either impulsiveness or Bets-16 for the male data (all $p > 0.05$).

As there were no significant differences between males and females on I-6 impulsiveness and venturesomeness scores, and Bets-16 scores, correlations were computed between Bets-16 and I-6 impulsiveness and venturesomeness with male and female date collapsed together. Correlational analysis using Spearman rank correlation coefficients revealed that there was a positive correlation between the I-6 Impulsiveness scale and the Bets-16 ($rho = 0.30$, $N = 61$, $p < 0.05$). Pearson product moment correlation revealed that there was a positive correlation between impulsiveness and venturesomeness which was at the margins of significance ($R = 0.25$, $N = 61$, $p=0.054$, two tailed).

5.1.3 Discussion.

Just over 30% of participants either failed to complete all of the tasks or completed them incorrectly and those participants were excluded from the analysis of the I-6 scales and the Bets-16 test. The majority of the participants who were excluded from the analysis (26.1%) had failed to complete one or more of the tasks, whilst only 4.5% completed one or more of the tasks incorrectly. The reasons for over a quarter of participants (26.1%) failing to complete one or more tasks are uncertain, but it is likely that either insufficient time and/or failure to understand what was required contributed to the high rate of non-completion.

A higher percentage of the current population of 13-14 year olds had tried smoking compared with the national statistics given for 14 year olds by Jarvis (1997) 43.2% versus 27%. However there were fewer reported regular smokers (9.1%) in this study compared with Jarvis's report of 14% of 14 year olds being regular smokers. Regular smokers were classified by Jarvis as those smoking one or more cigarettes per week and that was the criteria with which to classify current smokers in this study. The figures of those who had never tried smoking were similar, 33% in this study compared with Jarvis's 35%. Although females made up 37.5% of the original 88 participants, for whom there were smoking data, they comprised 62.5% of current smokers and 69.2% of ex-smokers. In comparison males made up a larger percentage of the group who had never smoked (75.9%) and the group who had tried smoking (65.8%).These percentages of males and female participants in the never smoked and tried smoking groups were more representative of the percentage of males (62.5%) and females (37.5%) in the study.

The group who reported only having tried smoking had higher impulsiveness and venturesomeness scores than the group who had never tried smoking. When considering the three groups who had smoked at one time or another (i.e. those who had tried smoking, the current smokers and the ex smokers) it is clear that all had similar impulsiveness scores. The group who had tried smoking also had the highest venturesomeness scores and this differed significantly from the group who had never tried smoking. Those who were current smokers might have been expected to have had the highest scores, however the results are in line with Morgan (personal communication) who found that impulsivity in smokers seemed to be state rather than trait dependent. Morgan found that non-abstinent smokers scored higher on a state measure of impulsivity than non-smokers. However as the current participants were minors and tested in school a considerable time would have elapsed since the current smokers had last smoked a cigarette. The two groups of smokers who showed differences were the two groups who consisted of mainly boys, therefore differences between groups cannot be attributed to sex differences.

The results show that 13 and 14-year-old males and females do not show any difference in risk-taking behaviour, as measured by the Bets-16 test. Both males and females tended to choose the sure thing, thus being risk averse. This is in line with the findings from an adult population (see chapter four) although the mean scores for adolescents are lower than those for adults. An explanation for these findings could be economic situation, in that adolescents have relatively less money than adults do and, consequently the return from the sure win choice may be even more appealing to an adolescent than to an adult.

The low correlation (0.25) between the impulsiveness and the venturesomeness scales of the I-6 is in line with Eysenck et al (1984) as they reported that there are low but consistent correlations between the impulsiveness and venturesomeness scales. They reported a correlation of 0.25 for females aged 14 and 0.26 for males aged 14 between I-6 impulsiveness and venturesomeness. The impulsiveness scale is considered to measure acting on the spur of the moment without being aware of any risk involved, whereas venturesomeness measures true risk taking and sensation seeking behaviour, and assumes the risk taker to be fully aware of any risks involved with their actions (Eysenck, S.B.G, 1993). Despite the impulsiveness and venturesomeness scales measuring different aspects of impulsivity the two scales do correlate, suggesting that there is some correspondence between the two scales and the different aspects of self-reported impulsive behaviour.

A correlation between the Bets-16 and the impulsiveness scale has also been found with adults (see chapter 8). However a correlation between the venturesomeness scale of the I-6 would be more expected as that is measuring risk where an individual is aware of the risk but engages in the behaviour anyway. However previous studies have reliably reported a low correlation between various measures of impulsivity, especially between objective and self-report measures (Gerbing et al, 1987; Parker, Bagby & Webster 1994).

The means for the three scales of the I-6, impulsiveness, venturesomeness and empathy were all within the age norms reported by Eysenck et al (1984). There were no differences between males and females on either venturesomeness or impulsiveness, but females scored significantly higher on empathy than males. Eysenck et al (1984) reported that males were significantly more venturesome and less empathic than females. Here females were significantly more empathic than males but not less venturesome. These results may reflect differences in females now, as the data Eysenck reported were from 1984. However the I-6 results found here were within norms reported by Eysenck et al (1984) suggesting that the present group were representative of that age population. The I-6 item number 68 "Do you like a lot of ketchup and pickles with your food" required clarification by some of the students. Due to this and as it is a filler question, not forming part of either scale, and it had previously been dropped from a Canadian study (Saklofske & Eysenck, 1983), it was decided to drop this item from the questionnaire for future studies.

Future studies will need to be done with other age groups of adolescents to assess the Bets-16 paradigm. Mean scores need to be established for the Bets-16 using a larger sample and a wider range of ages. The results from the Bets-16 paradigm suggests that 13 and 14 year olds are financially risk averse. As regards the Bets-16 paradigm it identified adolescents, like adults, as risk averse rather than risk seeking, and does indicate that the Bets-16 is a suitable tool to use with adolescents. It does require the establishment of mean scores for a wider age range with males and females.

The smoking questionnaire did not pose any difficulties for the participants, although some of those who had never smoked failed to ignore the instructions after question 1 which said "if you have never smoked then ignore the rest of this questionnaire". Many filled in the rest of the questions with "I have never smoked" or "I do not smoke". It therefore needs to be made clearer that if they have never smoked then they only answer question 1 and then ignore the rest of the questionnaire.

Overall the Bets-16 test, I-6 and the smoking questionnaire with slight modifications appear suitable tasks for a young adolescent population.

5.2 Experiment II – Piloting of the computer tasks.

5.2.0 Introduction.

Studies that have used operant choice responding to assess impulsivity in humans have typically found that as the delay to the larger delayed reinforcer increases, so the individual's preference for the smaller more immediate reinforcer also increases: that is as delays increase participants behave more impulsively. Impulsivity in the operant choice paradigm is defined as the preference for a small immediate reinforcer over a larger later reinforcer. In the laboratory, studies with humans have typically demonstrated self-controlled behaviour (Logue et al., 1990, 1986). Studies which have obtained impulsiveness in the laboratory situation have been with children (Schweitzer & Sulzer-Azaroff, 1988), mentally retarded adolescents (Ragotzy et al., 1988) or with negative reinforcement, such as termination of an aversive noise (Navarick, 1982). These findings that show people behaving with self-control appear to be in contrast to clinical problems such as overeating and gambling (Rehm, 1984) which have been explained by a lack of self-control. Laboratory studies using non-human species, usually pigeons or rats, consistently display impulsivity, i.e. they choose the smaller immediate reinforcer over the larger delayed reinforcer (Grosch & Neuringer, 1981). Non-human species typically display impulsiveness even when this results in less overall reinforcement. The differences between impulsivity in the laboratory and real life situations with adult humans may be due to the difference in the nature of the reinforcers used. Studies with non-humans typically use an immediately consumable (primary) reinforcer such as food or water, whereas studies with human adults often use conditioned reinforcers such as points which are exchanged for food or money at the end of the session. An immediately consumable reinforcer is one which must be utilised as it is delivered and cannot be saved up until the end of the session (Flora & Pavlik, 1992). In contrast a conditioned reinforcer is one whose properties are not intrinsic to it but are due to association with another reinforcer (the primary reinforcer), and cannot be utilised until the session is over. Unlike food used with animals, which can be consumed immediately, there appears to be no benefit in obtaining conditioned reinforcers immediately as they cannot be used until the session is over. Furthermore impulsivity in animals may well be adaptive for survival in food deprived animals (Logue, 1988).

Many of the studies that have looked at impulsivity and self-control within an operant choice paradigm have typically not kept reinforcement densities between the two choices equal for the session. Flora & Pavlik (1992) using secondary reinforcers, points exchangeable for money, reported that when there were no post reinforcement delays, choice was a function of reinforcement densities. Also in studies of humans if, regardless of choices made, reinforcement densities are not kept equal, then depending upon motivation it may be maladaptive to choose the larger later reinforcer. Indeed Logue,King, Chavarro & Volpe (1990) found that when responding for points exchangeable for money, impulsive behaviour (i.e. choosing the smaller immediate reinforcer) resulted in more reinforcement for the session than the self-control choice did. Logue et al, suggest that in such situations the participants were actually displaying self-control by choosing the response that in the long run resulted in more overall reinforcement. Sonuga-Barke (1990) has pointed out that with most studies on choice behaviour, choosing the smaller more immediate reinforcer ends the session quicker, and this may not be impulsive behaviour but delay averse. However delay aversion, or to phrase it another way, inability to tolerate delay can be considered an aspect of impulsivity when a multidimensional approach to the construct of impulsivity is adopted.

The current study hypothesised that as the delay to a larger later reinforcer increased so too would participants preference for a smaller immediate reinforcer. The reinforcement densities for the whole session were kept equal between the two schedules. This meant that at the end of the session, regardless of which button had been chosen on each trial, individuals within a condition had all received the same amount of delay and reinforcement. Therefore the choice was between a longer delay followed by a longer playing time on each trial or no delay but a shorter playing time per trial. At the extremes participants could choose either a few larger but delayed reinforcers or many immediate but smaller reinforcers.

A strong correlation has been reported between rate of temporal discounting in an operant choice paradigm where the reinforcer was hypothetical amounts of money and an impulsivity score derived from the Eysenck Personality Questionnaire (Ostaszewski, 1996). Ostaszewski found that high impulsives discounted the larger delayed reinforcer more steeply than low impulsives and suggested that this maybe due to the delay seeming subjectively longer to high impulsives.

A novel test is also piloted in the current study. The Walsh Test (Walsh, unpublished). This is a task in which two aspects of impulsivity, risk-taking behaviour and impulsivity, as measured by inability to withhold a response (response inhibition), are in opposition to each other. The task involves participants stopping a stimulus as it travels along a horizontal line. The object of the task is to score points to reach a target score. The longer they withhold a response the greater the risk that the stimulus will be terminated by the computer (termed a 'death') and they will not score any points for that trial. Therefore the longer one waits the greater the risk of not scoring any points on that trial, however participants need to withhold a response to obtain enough points to meet the target score. Therefore if one waits for a long time on each trial and then experiences many deaths and does not reach their target trial, is this due to risk-taking behaviour or self-controlled behaviour? The current study aimed to investigate this issue by assessing the convergence of the Walsh Test with financial risk-taking as assessed by the Bets-16 and impulsiveness and venturesomeness (thrill seeking risk taking behaviour.) as assessed by the I-6.

The second experiment in this chapter uses two computer tasks, 'Hungry Kevin' and the Walsh Test. The Walsh Test (Walsh, personal communication) was included in the second study reported here to assess the suitability of the test and also to attempt to establish whether it is a measure of risk taking behaviour or of inability to withhold a response. Such a situation makes it difficult to determine whether those who have exhibited delay aversion (on the operant choice task) will elect to reduce risk-taking by making early responses or increase risk by delaying their responses.

The aims of experiment 5.2 were to (i) test the correlation between objective and subjective measures of impulsivity, (ii) test the suitability of the operant paradigm, 'Hungry Kevin' for use with young adolescents and (iii) to pilot The Walsh Test as a measure of risk-taking and impulsivity. Questions which were of interest with 'Hungry Kevin' were whether young adolescents would be aware of the contingencies operating under the two schedules of delayed reinforcement and whether the game would be reinforcing enough, given the sophisticated computer games and game-boys to which most children and adolescents have access today.

5.2.1 Method

Participants

Time constraints and computer facilities limited the number of participants who could be tested to 30. All of these had taken part in the previous experiment, 5.1, and were chosen at random from a list of names of the 61 participants who had successfully completed all of the pencil and paper tasks in experiment I. An equal mix of males and females were chosen. Initially 30 participants were chosen but 3 participants were absent on the testing day, 5 declined to participate and 1 individuals computer failed to start the programme. Therefore twenty-one participated in experiment II. Initially 10 participants had been allocated for each of condition 1, 2 and 3. As 5 declined to participate and one individual's computer failed to start, there were 6 participants in condition 1, 7 in condition 2 and 8 participants in condition 3. These were 11 females aged 13-14 years, and 10 males aged 13-14 years.

Apparatus

The computer tasks were both DOS based programmes and were run on the school's computers. The tasks were displayed on VDU screens and the keyboard was used to start and to respond to both programmes.

Materials

Two computer-based tasks were used. One was the operant choice paradigm 'Hungry Kevin'. The second task was the Walsh Test (Walsh, unpublished) and measures inability to withhold a response and risk-taking behaviour.

Hungry Kevin

This was outlined in chapter 3. 'Hungry Kevin' is a computer based task that uses an operant choice paradigm with two concurrent schedules of delayed but continuous reinforcement operating. That is, individuals are reinforced (with timed access to a video game) after each operant response, sometimes after a delay. The delay they receive is dependent upon the choice they make, and the schedule of delayed reinforcement that they are exposed to. In the present study there were three conditions and each condition had different schedules of delay and reinforcement operating. Within a condition reinforcement densities between the two choices were equal, so regardless of the choice made in condition 2 800 seconds of reinforcement would be received in the session and in condition 3 1600 seconds of reinforcement would be received in the session. Condition 1 was included to establish whether people were showing colour preference and both choices operated the same conditions and total amount of reinforcement received across the session was 200 seconds of access to the game. The amount of reinforcement was the equivalent to 20 free choices of the larger later reinforcer. The schedules of reinforcement are shown below in table 5.2.1. The w key on the keyboard was covered with a round white sticker and served as the white key and the blue key was the b key on the keyboard covered with a blue sticker.

Table 5.2.1. The schedules of reinforcement operating under each choice button for conditions 1, 2 and 3 of 'Hungry Kevin'.

Condition	Operant response button	Pre reinforce - ment delay	Reinforce - Ment	Post reinforce – ment delay
1	White	0 seconds	10 seconds	6 seconds
	Blue	0 seconds	10 seconds	6 seconds
2	White	0 seconds	10 seconds	6 seconds
	Blue	18 seconds	40 seconds	6 seconds
3	White	0 seconds	10 seconds	6 seconds
	Blue	42 seconds	80 seconds	6 seconds

In the schedules of reinforcement operating under each choice shown in table 5.2.1, the white button always produced the smaller immediate reinforcer in each condition. Under condition two a white button response initiated a trial that provided a 10 second reinforcer in a 16 second trial and a blue button response initiated a 40 second reinforcer, after an 18 second delay, in a 64 second trial. Consequently one blue button response was equivalent to four white responses in terms of duration and reinforcement magnitude. Under condition three one blue button response was equivalent to eight white button responses. Sessions ended when reinforcement equivalent to twenty blue button responses had been given.

Scores can either be the proportion of impulsive responding or the percentage of impulsive responding. The proportion of impulsive responding is obtained by adding up the total number of impulsive choices made (white button responses) and dividing this by the total number of free choices made (white button responses plus blue button responses). A score between 0 and 1 is generated, with a choice proportion score of above 0.5 indicating impulsive responding and below 0.5 self-controlled.

The Walsh Test (Walsh, unpublished).

This is a task in which risk taking and inability to withhold a response are set in opposition to each other. Rather unusually in the Walsh Test risk taking involves waiting and withholding a response, whereas inability to delay responding is equivalent to risk averse behaviour. This is because participants are required to reach a target score and the longer a response is delayed on each trial the more points are potentially won. However the longer a response is delayed the greater the risk that the trial will be terminated by the computer(a 'death' occurring), in which case no points will be scored for that trial. The task consists of a straight horizontal line that is numbered from 0 (on the left) to 100 at intervals of 10. There are two blocks of trials, each block consists of 36 discrete trials. Participants were required to stop a ✳ which moved along the horizontal line from left to right. The ✳ was terminated randomly by the computer (a 'death') at some point along the line on 24 of the 36 trials in each block. On the other 12 trials the (✳) star would continue to the end to 100 without a 'death' occurring. Participants were required to try to reach a target set for each block. This was 1080, which is an average score of 30/trial. Participants had to attempt to reach the target score by terminating the star (✳) before the computer did (a death). If a death occurred before the individual had responded, then no points were earned for that trial. If the individual terminated the star (✳) then the number along the line at which they responded was the number of points that were added to their score. The s key on the keyboard was used as the response key to stop the ✳ at the point chosen by the participant. Written instructions were provided prior to the start and were as follows.

Instructions for the Walsh Test.

This computer task involves a star (✳) moving along a line that is numbered 0 to 100. In some of the trials the star will 'die' at a random point along the line, in other trials it will continue to the 100 point without 'dying'. If you have not responded before the star 'dies' then you will score no points for that trial. There is a target score set and you should aim to reach the target score. Your task is to stop the star at some point along the line before the computer terminates the star. The point at which you stop the star is the number of points that are added to your score. To stop the star press the S key on the keyboard. There are two blocks of trials, each block contains 36 trials. This task will take approximately 10 minutes to complete. Any further instructions appear on the computer screen. If you have any questions please ask before you begin.

Scoring the Walsh Task.

The number of deaths per block and the total score obtained on each block was generated for each participant. In addition the score for each trial and whether a death had occurred on that trial was also given. A mean score for the 12 trials at which no death occurred (score at infinity) was generated. High deaths indicate either risk-taking behaviour or delayed responding.

<u>Procedure</u>

The participants were shown into the computer room at their school and instructed to take a seat at a computer. They were given information about the study and asked to complete the consent form beside the computer, which included space for them to provide information on sex and their id. The five participants who declined to participate were sent back to their classroom by the computer technician who was also present. The remaining participants were then given instructions on how to load 'Hungry Kevin' and The Walsh Test, how to generate their id, and to put their id into the data output files on both tasks where it asked for a name. These instructions were written on the blackboard and were also given verbally. Following the information participants were instructed to proceeded to 'Hungry Kevin'. There was a short practice trial at the start to familiarise participants with the game and manoeuvring 'Hungry Kevin' around the screen. After the practice trial there were four forced choice trials, these were two forced choice trials of each of the blue and white buttons. Forced trials were given so as to expose participants to the contingencies operating under each response button. The four forced choice trials were followed by free choice trials. An additional two forced trials, one of each button, were given after half the sessions reinforcement had been given. Reinforcement densities were equal for all participants within a condition, regardless of the button they chose to respond on.

Following 'Hungry Kevin' the participants who remained were again given instructions on how to load The Walsh Test, how to generate their id, and to put their id into the data output file where it asked for a name. Instructions for the Walsh Test (as above) were provided beside the computer. Pressing the space bar started the programme. After the 36 trials in block 1 there was a rest. The participant determined the length of the rest. Block 2 proceeded in the same way as block 1.

Following The Walsh Test participants were debriefed as to the nature of the study. For those participants who had not taken part in the second stage of the study or remained to complete both tasks, a debriefing letter, and thanks to the students, was posted on the appropriate notice board for students to read. Students were informed by their teachers about the notice.

5.2.2 Results

Hungry Kevin

The percentage of impulsive responses were calculated for each participant, as described above. There was an increase in impulsive responding as the delay to the larger reinforcer increased across the conditions. This can be seen from the means in figure 5.2.1.

conditions 1 and 3 at the 5% significance level but not at p=0.017 (U = 6.0, N = 14, p = 0.02). There were no significant difference between conditions 1 and 2, or 2 and 3 (p>0.017).

<u>The Walsh Test.</u>

Following 'Hungry Kevin' two participants refused to complete the Walsh Test and six participants who had been assigned to condition 3 of 'Hungry Kevin' did not have time to complete the task before their next lesson and the data was lost. Therefore a total of 5 males and 8 females completed the Walsh Test. As was expected those participants with higher mean scores on the 12 trials at which the star (✳) would have continued to 100, if the participant had not responded, also had more deaths.

Group descriptive statistics for the 13 participants who completed the Walsh Test are presented in table 5.2.2. Data presented consists of the number of deaths for each block of trials (1 and 2), the score for each block on the 12 trials where the star (✳) would have continued to100 (score at infinity) and the total score for each block of 36 trials.

Table 5.2.2. Descriptive statistics for deaths, total score and score at infinity for each block on the Walsh Test. N =13.

	mean	SD	min	max
Death block 1	9.1	4.8	0	18
Score at infinity 1	52.4	19.2	17	86
Death block 2	11.3	5.9	3	24
Score at infinity 2	57.0	19.8	18	100
Block 1 total score	1116.3	371.3	314	1618
Block 2 total score	1093.5	264.3	301	1313

As can be seen in table 5.2.2. the number of deaths did not vary greatly from block 1 to block 2 and score at infinity and total score for each block were similar.

There was a significant correlation between deaths in block 1 and score at infinity in block 1 (rho = 0.76, n =13, p =0.002) and between deaths in block 2 and score at infinity in block 2 (rho=0.88, n=13, p<0.001). Due to the incorrect id being entered into the results file for most of the participants it was not possible to investigate the correlation between responses on the Walsh Test and 'Hungry Kevin', or between the computer tasks and the pencil and paper tasks.

5.2.3 Discussion

The increase in impulsive responding seen across the conditions in 'Hungry Kevin', suggests that as the delay to the larger later reinforcer increases so too does the participants preference for the smaller more immediate reinforcer. In condition 1 participants did not show a preference for either choice as would be expected with both choice buttons operating the same schedule. Condition 1 was included to assess whether there was a preference based on colour of the operant response button. The increase in impulsive responding seen as the delay to the larger later reinforcer increases suggests that participants find the delay aversive. Another explanation could be that they find the longer playing time aversive and therefore choose the smaller less delayed choice as it only gives them 10 seconds of playing time at any one time before the game is interrupted. This is unlikely as video game playing is considered a reinforcing event that is enjoyed by people and, adolescents spend hours in game arcades and at home playing such games. Unfortunately because participants were tested in groups they were not asked what choice they made and the reason for making the choice that they did. The results do however indicate that 'Hungry Kevin' is able to detect impulsive responding in adolescent humans when an immediately consumable reinforcer is used.

In 'Hungry Kevin' as reinforcement densities were kept equal, regardless of the choice response made, by the end of the session all participants within a condition had received the same amount of reinforcement, and the experimental session had lasted the same amount of time. Participants on 'Hungry Kevin' demonstrated impulsive responding under circumstances where the delay to the larger reinforcer was 18 seconds and where it was 42 seconds, with participants showing a preference for the smaller immediate reinforcer. Although there was a significant overall difference between the three groups, and results showed that participants in condition 3 displayed more impulsive responding at $p<0.05$, the results were not significant at the more stringent significance level. These results are in line with previous findings from 'Hungry Kevin' when reinforcement densities were kept equal, in that as the delay to the larger delayed reinforcer increased so too did participants preference for the smaller less delayed reinforcer (Montgomery, Personal Communication; Butler, Unpublished). Earlier studies indicate that this occurred up to a point, when delay to the larger later reinforcer was 90 seconds, there was then a shift back to choosing the larger later reinforcer as a group. Due to this a 90-second delay was not used in this study.

The results of the Walsh Test are interesting because it is unclear whether the task is measuring inability to withhold a response or risk averse behaviour. This is because the longer the individual waits before they respond, then the more chance there is that the ✳ will be terminated by the computer and no points will be earned. Since risk taking is considered to be an aspect of impulsivity, then as the game sets two aspects of impulsivity against each other, it is difficult to partition out which aspect of impulsivity is responsible for the participant responding. Not surprisingly there was a correlation between deaths and score at infinity. Those who had more deaths also had higher mean scores at infinity. This is expected because the longer a response is withheld the greater the likelihood that a death will occur. On the 12 infinity trials the star would potentially continue to 100, although participants are not aware of this, so these trials provide a measure of their true behaviour. The validity of the task requires further research with a larger population to investigate whether people who respond earlier are risk averse or unable to withhold a response and whether those who respond later and have more deaths are risk seeking, or controlled. After completion of the task participants could be asked about why they chose to respond earlier or later.

It had been intended to test convergent validity of the Walsh Test by investigating correlations with the 'Hungry Kevin', I-6 and Bets-16 scores. This however was not possible due to the incorrect code being entered by participants on The Walsh Test and/or 'Hungry Kevin'. Due to the low or non-significant correlations between various tests purporting to be measuring impulsivity this however may not be very informative. It may also be that the participants who chose to respond earlier are not risk averse but rather demonstrate inability to withhold a response. An alternative explanation is that they may be delay averse, in that the quicker one responds on trials the quicker the session is over (Sonuga-Barke & Taylor, 1992). However it is very difficult to establish whether The Walsh Test is measuring inability to withhold a response, delay aversion or risk aversion and more research is required to attempt to establish which aspect of impulsivity the Walsh Test is measuring.

5.3 General Discussion

Results from the first study revealed that rates of cigarette smoking amongst 13 and 14 year old were similar to the national statistics reported by Jarvis (1997). Furthermore they suggested that the relationship between smoking behaviour and impulsivity may not be a due to a personality trait, as the current and ex-smokers did not show any difference from the non-smokers in terms of self-reported impulsiveness. It also highlighted that a modification to the smoking questionnaire was required for those who had reported never smoking, to make it clearer that they were to ignore the questionnaire beyond question one.

Overall the two studies demonstrated that the tasks are suitable for a young adolescent population. Unfortunately due to being unable to match the tasks on id a correlation between I-6 and Bets-16 with the computer tasks was not possible. On the pencil and paper tasks the scores for the I-6 were within the age norms given by Eysenck et al (1984). The Bets-16 was understood by the majority of participants and the results paralleled those with an adult population, that people are risk averse and do not often choose the long shot.

The results of 'Hungry Kevin' were in line with previous research that has been undertaken, using the same schedules of delay (Montgomery, personal communication; Butler unpublished) which found that as the delay to the larger later reinforcer increased so did participants preference for the smaller more immediate reinforcer. The Walsh Test proved to be a suitable task for use with a young adolescent population however the aim was look at the intercorrelation between tasks especially the other objective tests, the Bets-16 and Hungry Kevin. Unfortunately due to lack of reliable identification codes the data were unable to be matched. This leaves interpretation of whether the Walsh Test is assessing inability to withhold a response or risk-averse behaviour difficult. Either reason could be postulated as to why some participants responded early and did not reach the target score. Also most behaviours where a person is risk averse often requires the withholding of a behaviour or response, yet in the Walsh Test to be risk averse a response is required earlier before the star is terminated by the computer and dies without any points being scored. Whilst the opposite is true of impulsive risk taking behaviour where this behaviour is often on the spur of the moment and does not involve the withholding of a response. Yet in the Walsh Test to be risk taking the withholding of a response is required for as long as possible, thereby increasing the chance that a 'death' will occur and points for that trial will be lost.

Overall the study, which was predominately a pilot, with the main purpose being to investigate the suitability of the tasks for an adolescent population was achieved. As has been noted a larger adolescent population would be needed to establish mean scores for the Bets-16 with a wider age range and a test retest with adolescents to assess the reliability with such a population would be useful. The present results also highlighted the importance of using a reliable means for identifying whose data are being recorded and to ensure that the generation of a code is understood by the population being tested.

The study in chapter 6 uses the measures piloted here, excluding the Walsh Test, with a population of adolescents and children who have received a DSM-IV diagnosis of Attention Deficit Hyperactivity Disorder.

Chapter Six

Impulsivity and risk-taking in ADHD

6.0 Introduction.

The studies presented in chapter 5 established that a variety of measures designed to assess a range of aspects of impulsivity, could be used, or adapted for use with adolescents. In the present chapter those measures were applied to adolescents with ADHD. The first study was a small scale pilot study that sought to assess the appropriateness of the measures for use with a sample of adolescents with ADHD. The subsequent study was designed to assess aspects of impulsivity in medicated adolescents with ADHD and to compare that group with age matched controls.

Children and adolescents with ADHD were one of the clinical populations chosen to investigate as the impulsivity aspect of ADHD is now considered important and this seemed an under-researched area especially with adolescents. Assessment of impulsivity in individuals with ADHD had usually relied on parent and/or teacher ratings of the behaviour, or had been assessed by the number of errors of commission on a continuous performance test. The exception had been the work with an operant choice paradigm by Sonuga-Barke and colleagues (see chapter 2 for a review). The participants in Sonuga-Barke studies however did not have a diagnosis of ADHD but were rated as being hyperactive by teachers. Furthermore, as outlined in chapter 2, ADHD is often associated with a higher prevalence of smoking, drug use and criminal activity, all behaviours that can be classified as impulsive and/ or risk taking. At the outset it was intended to only use an adolescent population, however it became difficult to recruit sufficient adolescents with ADHD and therefore pre-adolescent children (aged 9+) were also recruited.

Diagnosis.

A DSM-IV (APA, 1994) diagnosis of ADHD is usually given by a paediatrician or child psychiatrist, after a clinical assessment, and using information obtained from rating scales completed by parents and teachers. Behaviour rating scales are common assessment and diagnostic tools and Schachar (1991) suggests that although they have good reliability, their questionable validity may result in diagnostic variability. For a DSM-IV (APA, 1994) diagnosis of ADHD to be given the behaviour must be pervasive and the individual must have had the symptoms prior to age seven. ADHD is not just the naughty restless child, the problems these individuals have must significantly interfere "...with developmentally appropriate social, academic, or occupational functioning" (DSM-IV, p78). All children may display inattention, hyperactivity and impulsivity at one time or another and yet the levels are not abnormal. It is when the manifestations of these behaviours are excessive and persist well beyond age level norms that a diagnosis of ADHD may be given. Symptoms need to be persistent and more severe than is typically observed in individuals at a comparable age of development. DSM-IV criteria for ADHD are generally used in North

America and Australia whilst in the UK and Europe ICD-10 (WHO, 1994) classification is typically used giving a diagnosis of Hyperkinetic Disorder.

ADHD: A developing concept.

The emphasis on which symptom of ADHD was considered the predominant one has shifted. During the 1970s the emphasis shifted from hyperactivity to inattention and more recently has shifted again to impulsivity or behavioural disinhibition. In 1980 the DSM-III renamed the disorder from Hyperkinetic Reaction of Childhood, to Attention Deficit Disorder with Hyperactivity (ADDH) or without hyperactivity (ADD). This followed work by Douglas (1972) who argued that hyperactive children also had deficits in both attention and impulse control. Thus DSM-III viewed the disorder as multidimensional concept and for a diagnosis to be given an individual needed to display symptoms from all three categories. Changes to the next revision of the diagnostic and statistical manual to DSM-III-R (APA,1987) saw ADHD become a unidimensional concept and the category of ADD without hyperactivity was dropped. At this time for a diagnosis to be given an individual needed to have 8 out of 14 symptoms. This meant that an individual could be given a diagnosis of ADHD without there being any symptoms of hyperactivity and moreover 2 individuals with a diagnosis of ADHD might share very few symptoms. In the current DSM-IV (APA,1994) ADHD is again viewed as a multidimensional concept with three different categories. Whilst Schachar (1991) suggests that the differences in diagnostic criteria are not trivial, Cantwell (1996) suggests that although the number of core symptoms and their subdivision has differed from DSM-III, DSM-III-R and DSM-IV they are nonetheless fairly consistent. Furthermore Cantwell claims that all three versions of the DSM have general agreement that the core symptoms consist of inattention and hyperactivity/impulsivity. Where differences in diagnostic criteria do exist, it is between the diagnostic criteria of DSM-IV and those of ICD-10.

<u>DSM-IV & ICD-10 criteria.</u>

Whilst the diagnostic criteria between DSM-IV and ICD-10 differ there are some similarities. DSM-IV gives a diagnosis of ADHD of which there are 3 subtypes. These subtypes are

(1) predominately inattentive type

(2) predominately hyperactive-impulsive type

(3) combined type.

For a diagnosis of the predominately hyperactive-impulsive type and the combined type to be given the child does not actually have to have any symptoms of impulsivity, and there are only 3 symptoms of impulsivity listed under the diagnostic criteria, which are:

- Often blurts out answers before questions have been completed.
- Often has difficulty awaiting turn.
- Often interrupts or intrudes on other (e.g. butts into conversations or games).

The term 'often' used in the impulsivity (and inattention) criteria can be considered to be ambiguous and open to interpretation. Anastopoulos, Barkley & Shelton (1994) note that (inattention) items such as 'often has difficulty playing or engaging in leisure activities quietly' (DSM-IV) may be relevant for children but not in evaluating adolescents or adults.

According to DSM-IV "Impulsivity manifests itself as impatience. Difficulty in delaying responses, blurting out answers before questions have been completed, difficulty awaiting one's turn, and frequently interrupting or intruding on others to the point of causing difficulties in social, academic or occupational settings" (DSM-IV, APA, 1994; p79). The impulsivity associated with this disorder may lead to accidents and the child taking part in potentially dangerous behaviours without apparent consideration of the consequences of behaviour.

The ICD-10 (World Health Organisation, 1993) clinical diagnosis of Hyperkinetic disorder, which emphasises hyperactivity, has some common ground with a DSM-IV diagnosis of ADHD. However it only gives hyperactivity and inattention as the core symptoms and the ICD-10 clinical criteria do not include impulsiveness, although impulsive behaviour is acknowledged as being associated with Hyperkinetic disorders. Although the associated feature of impulsive behaviour is neither necessary nor sufficient for a diagnosis it can help to sustain it, and such behaviour is described as "...recklessness in situations involving some danger, and impulsive flouting of social rules (as shown by intruding on or interrupting other's activities, prematurely answering questions before they have been completed, or difficulty in waiting turns) are all characteristic of children with this disorder." (p263). Furthemore ICD-10 does note that "Hyperkinetic children are often reckless and impulsive, prone to accidents, and find themselves in disciplinary trouble because of unthinking (rather than deliberately defiant) breaches of rules".(p262). This is typically the type of behaviour associated with an impulsive individual.

The diagnostic criteria for ICD-10 hyperkinetic disorder are also more stringent than those for diagnosis under DSM-IV. ICD-10 clinical criteria, as mentioned, do not include any symptoms of impulsivity, only of inattention and activity problems which must be observed both at home (by parents, guardians) and at school (by teachers). For adults problems would be observed at work. A diagnosing clinician needs to enquire about behaviour in a variety of situations both at home and at school.

The introduction to hyperkinetic disorders in ICD-10 mentions that "...the use of the diagnostic term 'attention deficit disorder'...has been promoted in recent years" (p262). The ICD-10 claims that such a term is not used there as "...it implies a knowledge of psychological process that is not yet available..." (p262). Taylor and Hemsley (1995) claim that Hyperkinetic disorder is a subtype of ADHD. Kewley (1998) suggests that DSM-IV criteria give a broader and more realistic concept which includes all possible manifestations of the disorder, and those who believe that ADHD is a less severe form of ICD-10 Hypekinetic Disorder are mistaken in their belief. Taylor (1998) notes that different diagnostic traditions have resulted in different categories of the disorder and many words are used to refer to them. Taylor suggests that the term hyperactivity should be used to refer to a trait which is continuously distributed in the population and which represents restless, inattentive, impulsive and disorganised behaviour. Whereas ADHD is a disorder diagnosed according to the American Psychiatric Association and Hyperkinetic disorder refers to the category defined by the World Health Organisation's International Classification of Disease which is a subgroup of ADHD. It can be seen how confusion can arise as to whether different researchers are talking about the same disorder when using terms such as hyperactivity and ADHD. Indeed Schachar (1991) suggested that much of the conflicting research results may be due to the different diagnostic criteria used.

Many researchers (Barkley, 1990) suggest that there are two distinct disorders as diagnosed by DSM-IV, one which is characterised by inattention and the other which is characterised by hyperactivity and impulsivity. This is reflected in the current DSM-IV subtypes and the different comorbidity which accompanies the different subtypes. Those diagnosed with the predominately hyperactive-impulsive type typically have more drug use and abuse, are more likely to have a diagnosis of conduct disorder, and less likely to exhibit problems with selective or sustained attention (Barkley,1997). In contrast the predominately inattentive type are quieter and more likely to have learning disability than the predominately hyperactive-impulsive type. This subtype is also associated less with conduct disorder or oppositional defiant disorder.

This is also the subtype with which females are typically diagnosed (Lahey, Applegate, McBurnett et al, 1994).

Anastopoulos et al, (1994) point out that in view of findings (Barkley, 1990) which suggest that behavioural disinhibition or impulsivity may be the distinctive feature which distinguishes ADHD from other psychiatric disorders it is surprising that DSM-IV only has three symptoms pertaining to impulsivity and ICD-10 clinical criteria has none. Taylor (1998) further points out that in both ICD-10 and DSM-IV impulsiveness is operationalised in terms of rapid responsiveness. Thus both DSM-IV and ICD-10 view impulsivity narrowly, and seem to suggest that it is a unidimensional concept that can be captured by rapid responding. However when impulsivity is viewed as a multi-dimensional construct then rapid responsiveness is just one aspect of impulsivity and consequently tests which measure reaction (or response) time are probably only tapping into a narrow aspect of the impulsivity construct in people who have ADHD or other impulsive behaviour. This demonstrates that diagnostic criteria adopt a somewhat limited view of impulsivity and therefore impulsivity in individuals with ADHD warrants much closer inspection.

<u>Prevalence.</u>

Estimates of the prevalence of ADHD vary quite widely. Pennington & Ozonoff (1996) claim that prevalence rates in ADHD depend upon definitions and definitions vary in how pervasive they require the ADHD symptoms to be. This is seen with different prevalence rates between

ICD-10 hyperkinetic disorder and DSM-IV ADHD. For example Kewley (1998) reported that ADHD affects between 1 and 7% of the child population. DuPaul (1990) and Barkley (1990) both reported that estimates of childhood ADHD varied from 1-20% for the school age population. Overall the figure is generally put at between 3-5% of school age children (DSM-IV, 1994).

The disorder is more prevalent in boys than girls and a gender ratio of males to females ranging from 4:1 to 9:1 is given by DSM-IV. Barkley (1997) gives the ratio of boys to girls in childhood ADHD as 3:1. The variation in the male:female ratio depends upon the setting, whether it is a clinic population or the general population. However with the DSM-IV category of 'predominately inattentive' more girls are now receiving a diagnosis of ADHD than before. ADHD is often not picked up until the child begins school, as they are then put into a much more structured environment and are required to sit still and be attentive for longer periods of time. The symptoms are usually exhibited in multiple contexts, but not always. The level of dysfunction seen is often worse in situations which require periods of attention or sitting quietly, such as at school (Barkley, 1990).

Taylor & Hemsley (1995) put the prevalence of Hyperkinetic disorder in the UK as approximately 1-5% in 7 year old boys in inner cities, and 0.5-1% in the population as a whole of prepubertal children. According to these figures the prevalence of individuals diagnosed with Hyperkinetic disorder is much lower than that of ADHD. Rutter, Taylor & Hersov, (1994) give prevalence rates of 1.7% of the population of primary school boys. They suggest that the lower prevalence rates in the UK reflect differences in diagnostic practice rather than in actual prevalence rates. Taylor and Hemsley (1995) suggest that in a health authority in the UK with 50,000 children at least 250 (0.5%) will have hyperkinetic disorder with about 2,000 (4%) with attention deficit hyperactivity disorder. Reid & Maag (1997) noted that ADHD in the UK is conceptualised as a psychosocial problem, whereas in the United States it is viewed as a medical problem. It has been suggested that in the UK a diagnosis of conduct disorder tends to be given whereas the same child in the US would receive a diagnosis of ADHD (Prendergast et al, 1988). Indeed in ICD-10 when there are features of both hyperactivity and conduct disorder then a diagnosis of hyperkinetic conduct disorder should be given, whereas with DSM-IV a diagnosis of both ADHD and conduct disorder would be given.

ADHD was previously considered to be a disorder of childhood and it was felt that children grew out of these behavioural problems. Numerous studies have however shown this not to be the case for all those diagnosed with ADHD, and the prevalence rates beyond childhood vary. Klein & Mannuzza (1991) estimated ADHD to persist beyond childhood in approximately 40% of individuals with a childhood diagnosis. Longitudinal studies have given higher rates and reported that symptoms of childhood ADHD persist into adolescence in approximately 60% cases and into adulthood in approximately 10-50% (Gittleman et al, 1984). Others estimate approximately 60% of those diagnosed with ADHD in childhood will continue to have the condition into adulthood (Kewley, 1997). Barkley et al (1990) reported that more than 75% of children who are diagnosed with ADHD will have persistent symptoms at 15 years of age. However Biederman et al (1996) reported that in a 4 year follow up study 85% of children with ADHD continued to have the disorder while the other 15% had remitted. Whatever prevalence rate of ADHD into adolescence and adulthood is taken, what is consistent between the studies is that ADHD does persist beyond childhood and as noted in chapter two ADHD is generally associated with negative outcomes.

Psychopharmacological therapy.

By far the most common treatment for individuals diagnosed with ADHD is the use of the psychostimulant medication methylphenidate, known as Ritalin®. In the USA 90% of children diagnosed with ADHD are prescribed medication and most of those prescriptions are for stimulants (Cooper & Indeus, 1996). Government statistics showed that in 1995 0.03% of UK schoolchildren were receiving psychostimulants. In the USA this figure is around 100 times greater with 3% of schoolchildren taking psychostimulants. Barkley (1990) suggested that psychostimulants work by stimulating the reticular activating system and other related areas of the brain that are thought to control attention, arousal and inhibitory processes. It seems paradoxical to give a stimulant drug to someone who is overactive and cannot focus on the task in hand. However it is thought that individuals with ADHD have low arousal and are therefore trying to increase their arousal level. As psychostimulants increase an individuals internal arousal levels they become less in need of external arousal. This apparent paradox of giving a stimulant drug to those who appear overactive can be understood in terms of the rate dependency hypothesis of amphetamine action (Dews & Wenger, 1977). Dews & Wenger reported that amphetamine increased low baseline rates of responding whilst the same dose decreased high rates of responding. Drug effects are therefore an inverse function of baseline response rate. This would be seen in methylphenidate reducing hyperactive and impulsive behaviour but increasing attention, concentration and time on task.

Kewley (1998) suggests that psychostimulant medication is under used in the UK rather than over used. In the USA in 1990 approximately 750,000 children were receiving psychostimulant medication to treat ADHD symptoms, and it was suggested that up to 25% of these children may not respond to the drug (Schachar & Logan, 1990). The National Institute of Clinical Excellence (NICE) 2000 claim that 1% of school age children (about 69,000 in England and 4,200 in Wales) meet the criteria for the combined type of ADHD and approximately 48,000 of these are not on Ritalin®. This is 69.6% of those with ADHD which means that only 30% of children with ADHD are receiving psychostimulant medication in England and Wales (NICE, 2000). Furthermore they note that approximately 30% of children with ADHD do not respond to the drug. Kewley (1994) claims that more than 80% of children with ADHD respond to stimulant medication and there is usually a rapid improvement in concentration, distractibility and impulsivity.

Whilst psychostimulant medication is effective in approximately 70% of childhood cases of ADHD (Spencer et al., 1996), it has been reported that adolescents with ADHD are less responsive to such drugs, especially the 25-35% who have comorbid anxiety (Biederman et al., 1997). If ADHD symptoms are due to dysfunction in the dopamine system and these symptoms are treated successfully in childhood then why are adolescents less responsive to the drug? Perhaps there are some long term or developmental adaptations happening, or perhaps it is the comorbidity of anxiety which results in the lack of efficacy of psychostimulant medication.

Comorbidity: conduct disorder and beyond.

ADHD is often associated with comorbidity of either learning disabilities, conduct disorder, or oppositional defiant disorder (Kewley, 1998). Conduct disorder (CD) is characterised by a range of behaviours in which the rights of others and major societal norms are violated. Szatmari et al, (1989) reported that CD occurs in 50% of those with ADHD, and ADHD co-occurs in approximately 50% of those with CD. As impulsivity is a common symptom of both ADHD and CD it can be difficult to separate out whether it is the ADHD or the conduct disorder which predicts the presence of other behaviours which can be considered risk taking and impulsive, such as drug abuse and crime. Due to the high comorbidity of ADHD with CD and CD with ADHD, it is considered difficult to obtain either a pure ADHD group or a pure CD group for research purposes.

Despite this problem research into ADHD has been prolific. One widely used measure to assess the deficits in attention and impulsivity with ADHD, for research purposes and assessment, is the continuous performance task.

The continuous performance task (CPT).

The continuous performance task has been widely used with different populations in one variant or another since Rosvold et al (1956) originally designed it to assess brain damage. The CPT has also been a commonly used measure in one guise or another with children with ADHD to provide additional data during the clinical assessment and in research to investigate medication effects. Conners (1995) reported that the number of CPT errors decreased and reaction time increased with age, and this seemed to plateau out at around 12-13 years of age. Errors of omission (failing to respond to the target stimulus) are considered to be a measure of inattention whilst errors of commission (responding to a stimulus other than the target stimulus) are considered to measure impulsivity (Conners, 1995). Halperin and colleagues (1991, 1995) however suggest that only a certain type of error of commission is a measure of impulsivity. Using the AX paradigm where the task is to respond to the letter X but only when the previous letter had been an A, Halperin et al (1991) found that there were four types of errors of commission. These were:

1. A not X errors (responding to letters other than X following A).
2. X only errors (letter X not preceded by an A).
3. A only errors (responding to the letter A)
4. Random errors (responding to sequences of two letters containing neither A nor X.

They found that A not X errors had significantly faster reaction times than correct responses (hits). Halperin et al (1988) suggest that these are the impulsive errors and that X only errors, which had significantly slower reaction times than correct responses, represent inattention. Halperin et al (1995) reported that the initiation of fighting in children with ADHD was associated with impulsivity as measured by the CPT, but not with either of conduct disorder or oppositional defiant disorder. Halperin et al (1992) reported that on the CPT ADHD patients were more impulsive than controls whereas psychiatric controls were not. These results suggest that the CPT does have the ability to distinguish between ADHD and CD. van Leeuwen et al (1998) found that children aged 10 with ADHD made more errors of omission than a control group and also made more errors of commission of the A not X type and more X only errors compared to the control group. This pattern suggests both inattention and impulsivity. The ADHD group were particularly prone to A not X errors and they are in agreement with Halperin et al (1993) that these may indicate impulsivity. Johnson, Epstein, Waid, et al. (2001) found that on a CPT adults with ADHD made more errors of omission, but not commission, than non-

ADHD adults. This would seem to suggest that impulsivity as measured by the CPT was not a factor in adult ADHD.

Nigg, Hinshaw and Halperin (1996) found that an ADHD group did not differ significantly on an impulsivity score, which was errors of commission of the A not X type, although the ADHD group made more overall errors of commission. Shapiro & Garfinkel (1986) also reported that ADHD children were found to make more CPT errors of commission compared with a control group

On the CPT results such as slower reaction times, more errors and deterioration across trials have generally been reported in children with ADHD (Garland, 1998). In the van Leeuwen et al. (1998) study ADHD children also displayed longer (although not significant) reaction times to CPT hits than controls. This is in line with Nigg et al. (1996) who also reported that ADHD children aged 6-12 had significantly longer reaction times for CPT hits than a non-ADHD comparison group. Slower reaction times have also been reported on tasks other than the CPT. In a study with children classified as hyperactive responding on a task to the disappearance of a stimulus, hyperactive children had significantly longer reaction times compared to a control group (Sonuga-Barke & Taylor, 1992). Hyperactive children's reaction time also increased as the delay to the response required increased whereas the control group did not. This would however seem to suggest inattention.

Delayed reinforcement with an operant choice paradigm.

As reviewed in chapter two, Sonuga-Barke and colleagues (1992) proposed that their results from a delayed reinforcement task suggested that hyperactive children were delay averse and not impulsive as measured by an operant choice task. According to Sonuga-Barke et al (1992) and Sonuga-Barke & Taylor (1992) hyperactive children choose the smaller immediate reinforcer as it results in not only immediate reinforcement but more importantly a shorter session time. The data can be construed either as delay aversion or impulsivity, however it can be suggested that delay aversion is an aspect of impulsivity.

Sonuga-Barke et al (1998) suggest that in a choice situation the length of time before a response is made or before the delivery of reward is confounded with trial and session length. Sonuga-Barke et al (1998) claim this is because choosing the smaller more immediate reinforcer leads to shorter trials, a shorter session length and less overall delay, hence hyperactive children are delay averse and not impulsive. However if reinforcement densities between the two choices are kept equal across the session, as is the case with the operant choice paradigm chosen for experiment 6.1 and 6.2, then choosing the smaller immediate reinforcer does not lead to a shorter session length nor to less overall delay. The only aspects which are shorter are trial length and the amount of reinforcement earned on a given trial. However if shorter trials, the smaller immediate reinforcer, are chosen reliably, the number of trials per session will increase to keep session length and overall reinforcement constant.

Flora & Pavlik (1992) reported that choice was predicted directly from the relative reinforcement densities of the two choices. Most of the studies using points exchangeable for money or access to a video game or slide viewing, have used unequal rate and/or amount of reinforcement where choice of the small immediate reinforcer over the larger delayed reinforcer results in either less or more reinforcement over the total session (Flora & Pavlik, 1992; Logue et al., 1990; Millar & Navarick, 1984). This is seen in the studies of Sonuga-Barke and colleagues and those of Schweitzer & Sulzer-Azarof (1995). If all of these factors are kept equal then the only difference between the two choices is the immediacy of reward. Subjects who display impulsivity in these situations are therefore considered as finding the delay to the larger reinforcer aversive or intolerable as in the measure to be used in experiment 6.1 and 6.2, which overcomes the difficulties of previous studies by keeping reinforcement densities equal.

Self-report measures.

No studies were identified that had used the I-6 with either an ADHD or a hyperactive group. Shea & Fisher (1996) using only the impulsiveness scale of the I-6 with Canadian children aged 8-11 years, who had no diagnosed problems, reported that there were no correlations between teacher ratings of either hyperactivity, conduct problems or impulsiveness. White et al (1994) reported that boys aged 12-13 with serious delinquent behaviour (antisocial behaviour) had higher I-6 impulsiveness scores than non delinquent same aged boys. White et al (1994) claim that I-6 scores are not correlated with either IQ or socio-economic status (SES). Cooper

& Indeus (1996) reported that most research had shown that children with ADHD are of average or above average intelligence. In Sonuga-Barke and colleagues studies (1992, 1994, 1998) children classified as hyperactive had IQs which were average and did not differ from non hyperactive controls. Impulsiveness as measured by the I-6 does not appear to be associated with teachers ratings of impulsiveness, or IQ, and furthermore children with ADHD or hyperactivity do not appear to differ from non-ADHD children in terms of IQ. Impulsiveness as measured by the I-6 does appear to be associated with serious delinquent behaviour and this also does not appear to reflect IQ. Therefore based on these reports, findings of higher impulsivity in ADHD, ADHD with CD, or hyperactive children cannot be attributed to IQ levels.

The studies reported in this chapter were designed to (i) investigate the suitability of the impulsivity measures with youngsters with ADHD and (ii) to compare performance on the chosen measures of impulsivity between an ADHD group and a non-ADHD control group. The first study in this chapter was carried out to pilot the measures of impulsivity: 'Hungry Kevin', Bets-16, I-6 and the CPT on a population of adolescents with ADHD. The second study was carried out to investigate group differences between an ADHD group and controls on the above measures of impulsivity, and on attention as measured by the CPT.

6.1 Experiment I. Piloting the measures with an ADHD population.

This experiment was undertaken to pilot the suitability of the measures on a population of ADHD adolescents and to establish whether the tasks and the length of time required to complete the tasks would be appropriate for such a population. Again a variety of tasks which measure different aspects of impulsivity were chosen. Although only one study has been identified which used the I-6 with a young hyperactive population, the I-6 was chosen as it is the junior version of the I-7 which is one of the most commonly used self-report measures of impulsivity and White et al reported that it was not related to IQ. Like the I-7 it has been validated for a wide age range (see chapter 5). The Bets-16 had been piloted with an adolescent population, 13 and 14 year olds, which indicated that it was a suitable measure for adolescents of that age. The Bets-16 had been developed (refer to chapter 4) as a measure of risk taking behaviour and is quick and easy to administer.

The operant choice paradigm which involves a choice between a smaller more immediate reinforcer and a larger later reinforcer had been used with a hyperactive population by Sonuga-Barke and colleagues as mentioned earlier. Sonuga-Barke's studies used secondary reinforcers, points which were exchangeable for money after the session. The current operant choice paradigm 'Hungry Kevin' was chosen as it had appeared suitable with a wide age range from children to adults (Montgomery, personal communication, 1997) and had been piloted with 13 and 14 year old children for suitability (see chapter 5). Reinforcement used in the current paradigm is an immediately consumable reinforcer, access to a video style game, which is considered to be more intrinsically rewarding than secondary reinforcers. Problems in previous studies associated with uneven reinforcement densities are overcome by keeping reinforcement densities equal between the two choices. The CPT, in one variation or another, has been a widely used measure with children and adolescents with ADHD and is often used to provide additional information during an assessment for clinical diagnosis. This was chosen as it is a measure that has been used in previous research into ADHD with children and adolescents and generates both an inattention and an impulsivity score.

6.1.1 Method

Participants.

Five adolescents diagnosed with ADHD took part in the pilot study. They were aged 12,12,12.9, 13 and 15 (mean 12.98 ± 1.23). There were 4 males and 1 female. Participants were recruited through ADHD support groups in the Kent region.

Apparatus.

The continuous performance task and 'Hungry Kevin' were presented on, and data recorded by, a Phoenix NoteBIOS 4.0 multimedia notebook.

Materials.

Medication and diagnosis questionnaire.

This consisted of a series of questions which the parent or guardian of the participant was asked, with reference to the individual with ADHD. Interest was specifically in the type of medication taken, the amount per day and the number of times per day that medication was taken. The parent/guardian was also asked to note when medication had last been given and the time of testing was also noted.

I-6 (Eysenck et al, 1984). Is a 77 item questionnaire which contains three scales Impulsiveness, Venturesomeness and Empathy. It is suitable for ages 8-15. It is a forced choice questionnaire to which respondents answered yes or no by circling either option. This has previously been outlined further in chapter 5. Question 68 was dropped following the pilot study in chapter 5 due to problems associated with it and it does not form part of either scale,. This left a 76 item questionnaire that was used in the present study.

Bets-16. Refer to chapter 4.

Smoking questionnaire (unpublished). As used in chapter 5 (see appendix V).

'Hungry Kevin'.

'Hungry Kevin' had been designed with four conditions, but following earlier work, only condition two was used for this study. This was chosen as it was a schedule which generally produced self-controlled behaviour. The contingencies operating under each choice button are presented in table 6.1.1. Session length was approximately 30 minutes which was felt to be the maximum time that the game would be tolerated by individuals with ADHD. Scores are given as the proportion of choices of the smaller immediate reinforcer (impulsive responding) for the session.

Table 6.1.1 Schedules of reinforcement operating under the blue button and the white button for 'Hungry Kevin'. The white button represents the impulsive choice.

	Pre-reinforcement delay	Reinforcement Access	Post-reinforcement delay
White	0 seconds	10 seconds	6 seconds
Blue	18 seconds	40 seconds	6 seconds

The software is programmed so that across the session the same amount of reinforcement is delivered regardless of the choices made. Total reinforcement was set at the equivalent of 20 presses of the blue button, the larger delayed reinforcer. This gave a total of 800 seconds or 13.3 minutes of reinforcement across the session. The total reinforcement could be received in 20 trials each of 40 seconds of reinforcement or 80 trials each of 10 seconds of reinforcement or some combination of both.

CPT (Conners, 1995).

A shorter version of the CPT standard paradigm was set with 8 blocks of trials each containing 20 trials of which 10 trials within each block were target trials. This gave a total of 160 trials with 80 target trials. The stimuli were letters which were presented one at a time on the screen for 250 milliseconds. The stimuli consisted of the letters A B C D E F H I L M N O T X Y Z. The inter-stimuli interval varied from block to block and ranged from 5-25 seconds. Participants were required to respond to a target stimulus which was the letter X. Responses were made by pressing the space bar on the keyboard. Errors of omission and commission are recorded plus hit reaction time and errors of commission reaction time.

Procedure.

Participants were visited in their homes at a prearranged time. Information about the study had previously been sent out in the post and a consent form had been signed by a parent/guardian and returned prior to arranging a time to visit. On the day of testing, information was given to the child in the presence of their parent/guardian, and if the child agreed to take part then the measures were given. Measures were administered in two blocks, the pencil and paper tasks and the computer tasks. The order of completion was varied between participants. Some received the pencil and paper tasks first followed by the computer tasks, others received the computer tasks first followed by the pencil and paper tasks. The medication questionnaire was completed by the parent whilst the child was participating. Following completion of the data collection from both parties debriefing was given to participants and further information to the parent(s).

6.1.2 Results and Discussion.

Diagnosis and medication.

All diagnoses had been given by a paediatrician according to DSM criteria. Three of the boys and the girl had a diagnosis of ADHD and the other boy had a diagnosis of ADD. This reflects diagnostic criteria employed at the time of diagnosis (DSM-IV vs DSM-II-R). One participant had comorbid dyspraxia, and another had oppositional behaviour, but had not been diagnosed with oppositional defiant disorder.

All five participants were taking medication for their ADHD symptoms and this varied from individual to individual. Three participants took Ritalin®: one participant (2223) only took Ritalin®, a second also took Risperidone (2000) and the third participant was taking both Risperidone and Clonidine in addition to the Ritalin® (2222). The Clonidine was prescribed for the oppositional behaviour of the third participant. The other two participants who did not take Ritalin® were prescribed both Dexedrine and Clonidine (2220 and 2221). It was not established why those two children were prescribed Risperidone, which is an antipsychotic (neuroleptic) drug, however it is sometimes prescribed to aid sleep.

The effects of medication reported by the mother of child 2223 were that 'the child became more focused and not so highly strung and wound up'. The mother of child 2000 reported that 'he was more manageable and calmer'. The other participant's (2222) parents reported that when not on the medication their son 'could not keep his mind on anything, was excitable and easily led and does not see the danger or consequences involved in his behaviour, is not conscientious'. The parents of the girl (2221) and her brother aged 12 (2220) were both diagnosed with ADHD and their mother took Ritalin® and the father took Clonidine. Their mother reported that the effects of medication (participants 2221 and 2220) made her daughter and son 'less hyperactive, impulsive and argumentative and it enabled them to concentrate more'. When not on the medication their mother reported that they seemed to have a high pain threshold.

Time between medication and testing varied between participants. The female participant (2221) was self-medicating and her Clonidine medication was due when testing was finished. The last dose had been 4-5 hours earlier. Male (2220) had taken Clonidine ½ hour prior to being tested. For two males medication had been given at breakfast, and testing occurred at 10.30 a.m. for participant 2223 and at 11.00 a.m. for 2222. The fifth participant (2000) was due Ritalin® when testing had finished and had received Ritalin 2½ hours prior to testing.

None of the participants reported smoking or having tried smoking.

I-6, Bets-16, 'Hungry Kevin' and CPT results.

Participant (2000) refused to complete 'Hungry Kevin' and the data were therefore lost. The same participant also incorrectly completed Bets-16 and I-6 and the CPT was performed without care and attention. During the tasks the participant became aggressive and extremely restless and declined to stay to complete the tasks. The participant was on psychostimulant medication Ritalin® and this had been given 2 ½ hours prior to testing.

As can be seen in table 6.1.2 the scores for the remaining four participants on the I-6 showed a large amount of variability on the impulsiveness and venturesomeness scales. The venturesomeness score for participant 2220 was higher and empathy score lower than age norms given by Eysenck et al (1984) and was not within one standard deviation of those scores. The impulsiveness score for participant 2222 was also higher than the mean score for age given by Eysenck et al (1984). All other individual scores were within one standard deviation of the mean scores reported by Eysenck et al. (1984).

Scores from I-6 impulsiveness, venturesomeness and empathy, Bets-16 number of risky choices made, percent of impulsive choices on 'Hungry Kevin' and latency to make a choice on free choice trials on 'Hungry Kevin', CPT errors of omission, errors of commission, hit reaction time (responding to targets) and errors of commission reaction time for each participant are presented in table 6.1.2. Reaction times for CPT and latency to respond in 'Hungry Kevin' are in milliseconds.

Table 6.1.2. Individual scores and mean scores for the I-6 scales, Bets-16 number of risky choices, 'Hungry Kevin' percent of impulsive responding and CPT scores. Hungry Kevin latency to respond, hit reaction time and commission errors reaction time are in milliseconds. Figures in parenthesis are the percent of trials. N = 4.

	Participant				
	2220	2221	2222	2223	mean
Sex	Male	female	male	male	--------
Age	12	15	13	12	13.00
I	14	11	22	10	14.25
V	22	16	17	12	16.75
E	10	16	18	13	14.25
Bets-16	3	0	6	3	3.00
HK	92.0	95.0	78.0	5.0	67.50
HK latency	474.19	510.77	491.74	372.38	462.27
Continuous Performance Task (CPT)					
Omission	9 (11.2%)	2 (2.5%)	2 (2.5%)	4 (5%)	4.25
Commiss	14 (17.5%)	2 (2.5%)	18 (22.5%)	14 (17.5%)	12.00
Hit RT	428	491	337	402	414.50
Commiss RT	332	275	306	329	310.50

I=impulsiveness, V = venturesomeness, E = Empathy, HK = 'Hungry Kevin', Omission = errors of omission, Commiss = errors of commission RT = reaction time.

As can be seen in table 6.1.2 scores on the Bets-16 paradigm ranged from 0-6. There was a mean of 3 which is in line with the mean score results obtained from the 13-14 year olds in chapter 4. Participants had difficulties with the written instructions and they required clarification. It was highlighted that either simplified instructions needed to be printed for the main ADHD study or verbal instructions would be given. As dyslexia and reading difficulties are frequently comorbid with ADHD it was decided to give verbal instructions instead of written instructions for the main study.

As shown in table 6.1.2, 3 of the 4 participants were impulsive on Hungry Kevin' choosing the smaller immediate reinforcer most of the time. The fourth participant however demonstrated self-controlled behaviour and reliably chose the larger delayed reinforcer. On 'Hungry Kevin' of the four participants two (2221 & 2220) reported that they chose the white button, which operated the impulsive choice, as they did not like the delay to reinforcement associated with the blue button. The self-controlled participant (2223) reported that he chose the blue button as he got to play the game longer before it was interrupted again, the pre-reinforcement delay did not bother him. The fourth participant (2222) mostly chose the white button for the first half because he did not like the delay to reinforcement associated with the blue choice but changed half way through for the blue button as he got to play the game longer before it was interrupted again and this assisted him with his game strategy. It was clear from comments made by participants in the pilot study that the length of time taken to complete 'Hungry Kevin' was too long and so it was decided to reduce reinforcement amount to the equivalent of 10 blue button presses (400 seconds of reinforcement) for the main study.

On the CPT two participants had been given the task when they were seen by the paediatrician and diagnosed although not the X paradigm which was used in this instance. All four participants demonstrated low rates of errors of omission and three of the four demonstrated higher rates of errors of commission. The reaction times for responding to targets (hits) were longer than those for errors of commission. The results suggest that responding to a non-target (errors of commission) are associated with shorter reaction times and thus demonstrate fast and inaccurate responding. As half of the trials were target trials on the X version of the CPT it was felt that this may have contributed to the high errors of commission, and low rates of errors of omission. Furthermore as most previous studies had used the AX version it was difficult to compare the results with those of previous studies.

The I-6 although containing 76 questions did not appear to be too long. The main question which required explanation was the term impulsive from question 24 "Are you an impulsive person?" Otherwise participants did not appear to have difficulties with the I-6 and worked through it at a steady pace.

<u>Conclusions from pilot study.</u>

The I-6 appeared to be a suitable task for an adolescent population with ADHD and participants did not have difficulty with the questionnaire except for requiring clarification to the term impulsive. 'Hungry Kevin' was reported by the four who completed the task and gave feedback as being enjoyable although the interruptions annoyed or frustrated them. Also it became evident during the task that they became bored and distracted a little over half way through the task. They all commented that it went on for too long. It could be said that as impulsive people have difficulty delaying gratification and tend to act on the spur of the moment and cannot tolerate delay that is what would be expected. However it was evident that they had become bored and distracted from the task and the length of time for that task was too long and therefore it was decided to reduce the length of the task for the main study.

The instructions on the Bets-16 were deemed too difficult, although the 13 and 14 year olds in the adolescent study had appeared to have no difficulty with them. Therefore simplified verbal instructions are to be read out to participants for the main study. The concept of choosing between a certain win and a long shot was understood by the four participants whose data are reported.

6.2. Experiment II. Impulsivity in ADHD: Comparison with a control group.

6.2.0 Introduction

Following the pilot study it was decided to reduce the length of time that 'Hungry Kevin' took to complete. This was achieved by reducing the total amount of reinforcement for the session to the equivalent of 10 choices of the larger later reinforcer (blue button) instead of 20. This did not reduce the session for 'Hungry Kevin' by half as there were still the practice session and the four forced choice trials at the start and two after half of the reinforcement had been received. This reduced the length of the 'Hungry Kevin' session by 10-15 minutes.

The X only paradigm of the CPT was considered too short and with too many target trials. This had not been considered a problem until the pilot study had been conducted. Also it did not enable comparison with previous research which had predominately used the AX version of the CPT. Therefore the AX version of the CPT was chosen for the present study.

The other change as a result of the pilot study was that the written instructions on Bets-16 were replaced with simplified verbal instructions. On the I-6, it was felt that the term impulsive should be explained to all participants prior to them commencing the questionnaire, as some may not ask even if they do not understand. Furthermore it should be emphasised to participants to ask if they do not understand a question, and pointed out to them that many people do not understand some of the questions, thereby acknowledging that it is OK not to understand.

As the operant choice paradigm 'Hungry Kevin' measures inability to tolerate delay and the literature reported in chapter 2 found that hyperactive and ADHD children tended to discount delayed rewards and not tolerate delay, it was expected that the ADHD group would make more choices of the smaller immediate reinforcer than the control group. Impulsive behaviour is typically associated with shorter reaction times, however the literature reviewed has shown that ADHD children often have longer reaction times than controls. This apparent discrepancy between reaction times of impulsive people and those of ADHD children, who exhibit impulsive behaviour, makes it difficult to predict with any degree of confidence what type of reaction times an ADHD group will exhibit on free choice trials on 'Hungry Kevin' and when responding to target trials (hits) and non-target trials (errors of commission) on the CPT.

The ADHD group would be predicted to score higher on the I-6 scales of impulsiveness and venturesomeness. Unless comorbid conduct disorder was present then it would not be anticipated for there to be any difference between groups on I-6 empathy scores. It would be anticipated for the ADHD group to make more risky bets on Bets-16, thus demonstrating risk taking behaviour. Based on the literature surrounding the CPT the ADHD group would be expected to make more errors of both omission and commission, demonstrating both impulsive behaviour and inattention.

6.2.1 Method

Participants.

Fifteen individuals with a diagnosis of ADHD or ADD were recruited through support groups in the Kent region. There were 12 males aged 9-14.8 (mean 10.80 ± 1.95) and 3 females aged 8-13 years (mean 11.33 ± 2.89). All diagnoses were given by either a paediatrician or a psychiatrist according to DSM criteria (either DSM-III-R or DSM-IV). There were 15 control participants matched for sex and age. The control group males age ranged from 9-15 (mean 11.17 ± 2.25) and females were aged 9-13 (mean 11.33 ± 2.08). All controls were recruited through employees of the University of Greenwich who either responded to an email inviting children and adolescents to participate or they had been approached personally by the investigator. Control participants were entered into a prize draw with a first prize of £10 and a second and third prize draw of £5. Although ethnic and socio-economic information were not obtained, participants in both groups were all white with English as a first language. Parental occupation was taken. The controls were from families where one or more parent had a higher education qualification and were from social class I or II. Whilst the parents of the ADHD group were from a variety of occupational groups and these falling into social class II-IV.

Apparatus.

The continuous performance task and 'Hungry Kevin' were presented on, and data recorded by, a Phoenix NoteBIOS 4.0 multimedia notebook.

Materials.

The I-6 (Eysenck et al 1984).

Following the pilot study in chapter 5 question 68 was dropped ("Do you like a lot of ketchup and pickles with your food?"). This item does not form part of either scale and was dropped after the pilot study in chapter 5 thereby leaving a 76 item questionnaire. This still left 23 items in each scale with 7 items not forming part of any scale.

The Bets-16 test. See chapter 4 for details.

The number of risky bets chosen is scored, giving a score from 0-16 with higher scores reflecting risk-taking behaviour. Participants were told to ignore the written instructions on the first page of the Bets and verbal instructions were given to all participants as below.

Verbal Bets-16 instructions

'This is an imaginary betting task. You will not win any money for doing this but you are to imagine that you would win. Imagine there is a spinner in the middle of each circle, and if you were to spin the spinner then you would win whatever amount was in the section in which the spinner stops.' This was demonstrated on the practice by pointing to the relevant section on the pie chart at the same time. It was explained that 'for bet A there was an equal chance of winning nothing or of winning £10,000, whereas for bet B there was a large chance that you will win nothing (£0) and a small chance of winning £15,000'. Participants were then asked if they could only play one of the bets in the pair which one would they choose. Participants then pointed to either A or B and were instructed to 'circle the letter A or B'. They were then instructed that there were 16 pairs of these bets on the next four pages and that for each pair they were to choose either A or B and indicate their choice by circling A or B. This was shown on the first page where the first four pairs of bets are. Participants were told that there were no right or wrong answers and it was simply a matter of their choice. They were instructed to answer as if there was real money involved. They were then asked to repeat to the investigator what they were to do and if there were any questions. If there were no questions and participants had demonstrated that they understood the task, they were instructed to proceed with the task.

Smoking questionnaire (unpublished).

This was used in the pilot study in chapter 5 and in experiment 6.1 and is an 8 item questionnaire designed to assess whether an individual has smoked or not and if so how much and the reasons for smoking.

The CPT (Conners, 1995).

This was outlined in chapter 3. The AX paradigm was used in this study. It takes 10 minutes to complete. Participants responded to the target stimulus, which is a letter X which has been preceded by the letter A. Responses are made by pressing the space bar. There were 400 trials and 40 of these trials were target trials.

'Hungry Kevin'.

This was described in detail in chapter 3. Condition 2 was used in this experiment as in the pilot study, except the length of time taken to complete the session was reduced. The contingencies of delayed reinforcement operating each button are shown in table 6.1.1. The W key on the keyboard was covered with a white adhesive circle and functioned as the white key which always operated the impulsive choice. The B key was covered with a blue adhesive circle and functioned as the blue key and was the self-control choice. It took approximately 15-20 minutes to complete 'Hungry Kevin'. The programme terminated the game when reinforcement equal to 10 blue button presses, which is 400 seconds of reinforcement, had been received. Each trial of the choice of the delayed larger reinforcement took 64 seconds whereas each impulsive choice operating under the white key took 16 seconds per trial. There were four forced choice trials at the start of the test and then one forced choice trial of each button press when half of the reinforcement had been received, after 200 seconds of access to reinforcement.

Procedure.

The ADHD sample were all seen in their homes either after school, during school holidays or on the weekend. Five of the control participants were seen at the University of Greenwich and they were seen in one of the psychology departments testing laboratories. The other 10 control participants were seen in their homes after school, during school holidays or on the weekend. The five control participants seen at the University of Greenwich were seen on a one to one basis. It was attempted to see those tested in their homes on a one to one basis however the parents were often in the room at some point during the testing session. For some this was only for a short time and for others this was more frequent depending upon where in the house testing took place.

The ADHD participants were visited in their homes at a prearranged time. Information about the study had previously been sent out in the post and a consent form had been signed by a parent/guardian and returned prior to arranging a time to visit. On the day of testing, information was given to the child in the presence of their parent/guardian, and if the child agreed to take part then the measures were given to the individual with ADHD and the medication questionnaire to the parent/guardian. For the control participants, the parents responded to an email calling for participants and the study had been briefly explained to the parents during a telephone call to arrange a time to visit. Information was provided to both the parent(s) and participant upon arrival at their home or their arrival at the University of Greenwich. An opportunity to ask questions was given and then parents were asked to sign a consent form and some of the participants also signed a consent form if they wished. After informed consent had been obtained, for half the participants pencil and paper tasks were given: the 1-6 was administered first, followed by then the Bets-16 and then the smoking questionnaire. For the other half of the participants the computer tasks were given first: 'Hungry Kevin' followed by the CPT.

The written instructions for the I-6 were read out to participants and they were instructed to ask if there were any questions that they did not understand. When this was completed the experimenter checked that all questions had been answered and then the Bets-16 was given and the verbal instructions read out. Upon completion of the Bets-16 the smoking questionnaire was given and they were informed that this information would not be given to their parents and to answer honestly. For those who received the pencil and paper tasks first this was then followed by 'Hungry Kevin'.

Participants were given time to read the instructions for 'Hungry Kevin' on the VDU and then they were given verbally. When verbal instructions for 'Hungry Kevin' were being given the arrow keys on the keyboard were indicated and the blue and white buttons. After completion of 'Hungry Kevin' participants were asked which button they pressed most during the free choice trials and why they chose the button they did. They were also asked whether they had enjoyed the game or not and if there was anything they wished to add about it. Finally the CPT was administered. The whole session lasted approximately 60 minutes. Upon completion of all the tasks participants were debriefed and further information provided to the parent(s).

6.2.2 Results.

The experimental group comprised 12 participants diagnosed with ADHD and 3 diagnosed with ADD. This reflects different edition of DSM diagnosis given. The time since diagnosis ranged from 11 months to 50 months with a mean of 36 months (± 13.66).

None of the ADHD group or the controls (0.0%) reported having ever tried smoking. For the control group if the parent was in the room when this question was asked they all left the room. However for the ADHD group many of the parents were interested to know what their child said and most of the children did not fill in the form but said that they had never smoked.

Dyslexia was comorbid in 4 (26.67%) of the ADHD group. Learning difficulties and conduct problems, but not a diagnosis of CD, were reported in one participant (6.67%). One of the control males (6.67%) was dyslexic. No other learning difficulties or problems with reading were reported by the parents of the other controls.

Medication.

Fourteen of the fifteen (93.3%) ADHD group were being treated for symptoms with the psychostimulant medication Ritalin® (methylphenidate). One participant was self-medicating and the remaining 13 were given medication by their parents and a lunch time dose by their school. Ritalin® comes in tablet form each tablet providing 10mg of methylphenidate. Dose ranged from 15mg per day to 60 mg per day with the mean being 30mg per day. The number of times per day that the medication was taken was available for 11 of the 14 medicated participants. The lowest reported daily dose was 15mg, and this was taken by one participant in 2 doses: 10mg was taken at time 1 and 5mg at time two. The highest reported daily dose was 60mg per day and details on the number of doses per day and the amount per dose were unavailable. This was the participant who was self-medicating and he said that he took it when he felt he needed it, and this varied from day to day. Another participant took 55mg per day and this was taken as 5 x 10 mg doses and 1x 5mg dose throughout the day. The mean number of times per day that medication was taken was 3 and ranged from twice a day to 6 times per day.

In addition to Ritalin® one participant also took Tofranil at night for anxiety. Another who was taking Ritalin® also took Vallergen (a sedative) at night for what was described by her parents as 'night terrors'. Time since the last dose of medication prior to testing ranged from 30 minutes to 480 minutes (8 hours) with the mean being 210 minutes ± 169.73 (3.5 hours). None of the controls were taking any medication of any type as reported by their parents.

The main benefits of the psychostimulant medication listed by most parents were that the children were calmer, able to concentrate better and they were not so impulsive. Other benefits given by the parents were that their child(ren) were able to discuss issues, were more acceptable to others, and they were more controlled.

Pencil and paper tasks: I-6 and Bets-16.

Mean scores for the I-6 scales were within one standard deviation of the means given by Eysenck et al (1984). One participant in the ADHD group after completing the computer tasks refused to complete the two pencil and paper tasks. Mean scores for both groups are given in table 6.2.1 for the three I-6 scores and the Bets-16.

Table 6.2.1. Means and standard deviations for the I-6 scales (I,V,E) and Bets-16 number of risky bets chosen.

	Controls n = 15		ADHD n =14	
	mean	SD	mean	SD
I	11.47	5.72	16.64*	4.58
V	16.67	5.07	16.00	4.72
E	17.00	3.38	13.14*	5.96
Bets-16	1.80	3.28	5.21*	5.42

I = impulsiveness, V = venturesomeness, E = empathy. * $P< 0.05$ (two-tailed).

As can be seen in table 6.2.1 the mean score for impulsiveness was higher for the ADHD group compared with the controls. This difference was significant ($t = -2.67$, $df = 27$, $p = 0.012$). Mean scores on venturesomeness were not significantly different between the two groups ($t = 0.37$, $df = 27$, $p = 0.72$). The ADHD group had lower scores on empathy than the control group and this difference was statistically significant ($t = 2.16$, $df =20.28$, $p =0.046$). The ADHD group also chose significantly more risky bets than the controls ($U =56.00$, $N =29$, $p = 0.03$).

Computer tasks: 'Hungry Kevin' and the CPT.

The means and standard deviations for the computer tasks are given in table 6.2.2. Scores for 'Hungry Kevin' latency to respond, CPT hit reaction time and CPT errors of commission reaction time are all given in milliseconds. Scores for 'Hungry Kevin' given in table 6.2.2 are the percent of impulsive responding for the session. Due to one of the ADHD group and two of controls not making any errors of commission, the number of participants is reduced for errors of commission reaction time.

Table 6.2.2. Means and standard deviations for 'Hungry Kevin' and CPT scores. Scores on 'Hungry Kevin' are the percent of impulsive choices for the session. Reaction times and 'Hungry Kevin' latency scores are in milliseconds. N = 15 in each group.

	Controls		ADHD	
	Mean	SD	Mean	SD
HK choice	76.00	30.00	68.00	28.00
HK latency	497.89	96.47	509.32	75.40
CPT Hit RT	414.00	79.75	437.07	58.07
CPT Com. RT[†]	399.30	134.83	558.71[a]	169.12
CPT Omission	0.93	0.96	2.67[b]	3.15
CPT Commission[†]	5.07	4.15	16.27	28.89

a $p < 0.025$, b $p = 0.051$. † n = 13 for controls and 14 for ADHD group. HK = Hungry Kevin, CPT = continuous performance test. RT = reaction time, Com = errors of commission, omission = errors of omission.

As can be seen in table 6.2.2 both groups showed a preference for the impulsive choice in 'Hungry Kevin' and there was no statistically significant difference between the control group and the ADHD group ($t = 0.71$, $df = 28$, $p = 0.48$) on choice preference.

As can be seen from table 6.2.2 the ADHD group had slower reaction times for all three measures, 'Hungry Kevin' latency, CPT hits and CPT errors of commission, but CPT errors of commission reaction time was the only reaction time score which was significantly different between the two groups ($t = -2.70$, $df = 25$, $p < 0.02$).

There were no significant differences between the groups on errors of commission despite the ADHD group having the tendency to make more errors of commission ($U = 86.50$, $n = 30$, $p = 0.29$). The ADHD group also had a tendency to make more errors of omission, which represents inattention, than the control group and this was at the margins of significance ($t = -2.036$, $df = 28$, $p = 0.051$).

As four of the ADHD group and one of the controls were dyslexic, and this may be a confound on performance on the CPT, the CPT data was reanalysed with the five dyslexic participants omitted. All significant differences between groups remained and no other significant differences were found. The difference between groups on errors of omission remained at the margins of significance ($p = 0.058$).

<u>Correlations between measures.</u>

Correlations coefficients were computed for each group separately. There was only one significant correlation in the control group and this was a negative correlation between CPT errors of omission and CPT hit reaction time ($R = -0.55$, $n = 15$, $p = 0.03$).

Significant correlations in the ADHD group data were between Bets-16 and CPT errors of omission ($rho = 0.64$, $n = 14$, $p = 0.014$), CPT errors of commission and impulsive choices on 'Hungry Kevin' (rho = -0.63, n =15, p = 0.012). Empathy correlated negatively with impulsiveness (R = -0.61, n = 14, p = 0.021). CPT hit reaction time correlated negatively with venturesomeness (R = -0.56, n = 14, p = 0.04) and positively with impulsive choice responding on 'Hungry Kevin'. There were no significant correlations between time since medication last taken and any of the measures (all $p>0.05$) in the ADHD group.

6.2.3 Discussion.

As 93.3% (14 out of 15) of the ADHD group were on psychostimulant medication it makes interpretation of the data difficult as the effects of medication are to increase attention, and decrease hyperactivity and impulsivity associated with ADHD. Although the time since medication had last been taken and daily dose varied between individuals and information on this was missing for three individuals, there were however no correlations between any of the measures and time since the last dose of medication had been taken. The parents reported positive effects of psychostimulant medication on their child's behaviour, such as being calmer, more able to concentrate and reduced impulsive behaviour. Other benefits given by the parents were that their child(ren) were able to discuss issues, were more acceptable to others, and they were more controlled. These findings are similar to those of Wright (1997) where parents reported that on Ritalin medication their child was calmer, concentrated better, aggressive behaviour had decreased and compliance had increased.

The I-6 is a self-report questionnaire where participants indicate whether they would engage in certain activities or have certain feelings. Under the present circumstances the question arises as to what time period the ADHD group are self reporting, i.e. do they report what they would do at the time of participation when they are on the medication or when they are medication free? Obviously interpretation of these findings will be crucially influenced by the answer to this question.

It is clear that the ADHD group scored higher on self reported impulsiveness but not on venturesomeness. There was no difference between the groups on I-6 venturesomeness, which is the risk taking behaviour where an individual is aware of the risks. The behaviours that the venturesomeness scale asks about are adventurous activities such as "would you like to go deep sea diving". However the ADHD group did score significantly higher on self-reported I-6 impulsiveness which is measuring more pathological risk taking, that is impulsive risk taking behaviour. Behaviours measured by the impulsiveness scale are those which relate to acting on the spur of the moment and without forethought to the consequences of behaviour which is characteristic of the behaviour of individuals with ADHD. These differences between groups cannot be attributed to differences in age or sex as the control group were matched with the ADHD group for age and sex.

It could be suggested that an effect of medication is to lower risk taking behaviour where an individual is aware of the risks (venturesomeness), if participants were self-reporting with reference to their medicated condition, but not to lower impulsive risk taking behaviour (impulsiveness). However the ADHD group chose significantly more risky bets on the Bets-16 than the control group. This is a task where some thought needs to be given to the options before a choice is made. If the safe bet was chosen, where there was a guaranteed win, then participants said they had made that choice because you would definitely win something even if it was a smaller amount. Where the risky bet was chosen then participants said this was because there was a chance of winning more money. Thus participants in both groups were able to articulate the reasoning behind their choice which suggests that some thought was given to the choice that they made and that the chances associated with each choice were understood. Whilst the Bets-16 is measuring risk taking behaviour it is related to financial risk taking. This could suggest that these children and adolescents are not cautious with money and are more likely to take the gamble. However the results are interpreted, it is clear that individuals with ADHD demonstrated more risk-taking behaviour as measured by the Bets task even when medicated.

The ADHD group had lower I-6 empathy scores than the control group which reflects less empathy. This would not be surprising in those with comorbid conduct disorder and Szatmari et al, (1989) reported that CD occurs in 50% of those with ADHD. However according to the parents none of the current group had comorbid conduct disorder. Perhaps a more reliable account of comorbidity would be obtained from the diagnosing paediatrician or psychiatrist. It is however unlikely that the parent's would have withheld information about comorbidity when they were open with other information. One of the participants in the ADHD group had set fire to the family house four years prior to the study and now one of the parents remained awake during the night as the adolescent boy only slept a few hours per night and they were fearful of what he might do when he awoke. This behaviour suggests conduct problems, however no conduct disorder had been diagnosed. Fasnacht-Hill (2001) found no difference between male adolescents with CD, ADHD or controls on empathic concern or an overall empathy scale. However Braaten & Rosen (2000) reported that on an empathy response task ADHD males (aged 6-12.8 years) were less empathic than non-ADHD males. However no differences were reported between the groups on emotional intensity or emotional reactions.

The ADHD group had a tendency to make more CPT errors of commission compared to the control group, which according to Conners (1995), is an impulsivity score, however this difference was not statistically significant. Previous studies have found that children with ADHD do make more errors of commission (Conners, 1995). However Halperin et al (1991) have distinguished between four different types of errors of commission and claim that the A not X errors (responding to letters other than X following A) are the impulsive errors and other errors of commission do not reflect impulsivity, and are more indicative of inattention. Halperin et al (1992) found that children with ADHD do make more impulsive errors of commission (the A not X variety) than controls. However Nigg et al (1996) did not find that an ADHD group made more impulsive errors of commission. Nigg et al also reported an effect of methylphenidate medication in that it lowered errors of both omission and commission in a dose dependent fashion. The version of the CPT used in this study does not distinguish between different types of errors of commission, which would be a useful distinction to make in the future.

In his normative data Conners (1995) reported that methylphenidate medication improved reaction time on the CPT for individuals with ADHD aged 6-17. Kirby, VasndenBerg, & Sullins [(1993) cited in Conners, 1995] administered the CPT to a group of children diagnosed with ADHD and those referred by parents or teachers to see whether a child met the diagnostic criteria for ADHD. They were administered the CPT whilst on medication and off medication. Whilst on medication reaction times were faster compared to off medication, and the percentage of hits was higher while on medication. There was no effect of medication on errors of commission however.

In the present study the ADHD group had significantly longer reaction times for errors of commission than the control group, therefore they were slower to respond incorrectly. Although the results reported above found that reaction times increased under the effect of medication, an explanation for the slower reaction times on errors of commission with the ADHD group in the current study may be that the psychostimulant medication had resulted in a reduced motor speed and this would be compatible with the literature which reports that symptoms of hyperactivity and impulsivity are reduced by psychostimulant medication such as Ritalin®. This may also explain the tendency of the ADHD group to have slower reaction times for CPT hits, although they were not significantly different from the control group. This is in line with findings of van Leeuwen et al (1998) and Nigg et al (1996) who reported that ADHD children had longer reaction times to CPT hits.

Whilst the two groups did not differ significantly on the number of non-target trials they responded to (errors of commission), which is considered by Conners (1995) to be a measure of impulsivity, the ADHD group failed to respond to more target trials (errors of omission) compared with the controls and this was at the margins of significance. Nigg et al (1996) and Halperin et al (1991) classified errors of commission where an individual responds to an X which had not been proceeded by an A as an inattention score, and noted that an ADHD group had more errors of this type compared to a non-ADHD group. As a greater percentage of the ADHD group had comorbid dyslexia (26.67%) compared to the controls (6.67%) then this may have been a confound on CPT performance for that group. However when those with dyslexia, from both groups, were omitted from the analysis the results on the CPT that had been found remained.

The results of the present study on the CPT suggest that the ADHD group are more inattentive, but not more impulsive, and that they respond slower to both targets and non-targets compared with a non-ADHD group. The results may be an effect of medication, in that previously high rates of behaviour, such as impulsive behaviour, where a response is unable to be withheld are reduced and are comparable to a non-ADHD group. Whereas low rates of attentive behaviour have not been increased to a level equal to that of non-ADHD participants. This is not in line with the rate dependency effect of amphetamines proposed by Dews & Wegner (1977).

As regards the operant choice paradigm 'Hungry Kevin', although both groups were impulsive in their choice responding it was the control group who made a higher proportion of impulsive choices, although not significantly different from the ADHD group. These findings are not in line with previous results which have found that ADHD children show more preference for the smaller more immediate reinforcer than a control group (Sonuga-Barke et al 1992). These results do not support Sonuga-Barke's theory that children with ADHD are delay averse as they had a tendency to chose the larger delayed reinforcer more than the control group, (although it did not differ significantly) and they had a tendency to take longer to make their choices in free choice trials. If the ADHD group were delay averse then it would be expected for them to consistently choose the smaller more immediate reinforcer in an attempt to complete the session faster. Participants were not told that their choice would have no effect on the length of the session. What they were told was that it would take approximately 15-20 minutes to complete 'Hungry Kevin'. Based on the findings of Barkley et al (1997) who reported that methylphenidate medication had no effect on sense of time in time reproduction tasks in children with ADHD, it is unlikely that medication made the passage of time pass faster and enabled the ADHD group to wait longer on some trials. An effect of the medication may be to enable individuals with ADHD to wait more for delayed rewards, that is they may not discount delayed rewards as much when on medication. Having a tendency to be slower to make a choice on free choice trials may have been due to inattention or distraction and they did not see the prompt on the screen asking them to make a choice. Resolution of these problems of interpretation would require testing on medication and off medication, and ensuring that testing on medication took part at a set time after ingestion of medication.

Correlations between the measures for the control group only yielded one significant correlation and this was a negative correlation between CPT errors of omission and CPT hit reaction time. This indicates that those controls who responded faster to targets on the CPT also failed to respond to more targets. There were five significant correlations between measures in the ADHD group. These were varied and demonstrated that those individuals with ADHD who were more risk taking on the bets, made more risky choices, also missed responding to more target stimuli on the CPT, and those who responded to more non-targets on the CPT (made more errors of commission) were also more impulsive on 'Hungry Kevin'. Impulsive responding on 'Hungry Kevin' was also associated with faster responding to target stimuli on the CPT. There was also a negative correlation between empathy and impulsiveness which was not expected from the findings of Eysenck et al (1984). These correlations demonstrate that those who were impulsive on the CPT were also impulsive on 'Hungry Kevin, and those who were impulsive on 'Hungry Kevin' were slower to respond to target stimuli on the CPT. Those who were risk taking on the Bets were also inattentive, and that those low on empathy are more risk taking. Most of the significant correlations found with the ADHD group were with CPT scores. The only correlation between measures of impulsivity was between impulsive responding on the CPT and on 'Hungry Kevin' which further reflects the lack of correlation between the measures of impulsivity.

Barkley (1990) acknowledges that impulsivity is multi-dimensional in nature and claimed that it remains unclear which aspects of impulsivity are problematic for children with ADHD. It is unknown whether there were no differences on some of the measures in the present study due to the effect of medication, in that some types of impulsivity might have been reduced as a consequence of medication or whether this group were not different in terms of impulsivity from non ADHD children and adolescents. Where the ADHD group showed greater impulsivity and risk-taking this may reflect that medication is ineffective or that the effect is iatrogenic (i.e. actually caused by the medication). As the Bets-16 has not been used with an ADHD group, and only one study using the I-6 with a hyperactive group had been identified, conclusions are difficult. Also the variability in time between medication being taken and testing occurring, the number of doses taken per day and the dose taken at each time makes a unified effect of medication impossible to determine.

To test the nature of impulsivity in ADHD and the extent of the effects of medication on impulsivity, individuals would need to be tested when they are on medication and then when medication free so they could act as their own controls. However due to ethical considerations and lack of involvement with the prescribing physician this was not possible as the participants did not have any periods (i.e. school holidays) when they were medication free. In addition to being unable to determine the effects of medication, data on medication details were missing for some participants, including information on the time since the last dose of medication. Where this information was available, the time since medication and testing varied greatly from 8 hours to only ½ an hour. As it has been reported that the effects of Ritalin® medication last 4 hours, then those who were tested longer than four hours since the last dose of medication or nearing the end of this time period may have been without the effects of the medication. This is referred to as the wear off effect. The wear off effect refers to a return of symptoms to baseline levels once the serum drug level falls after 3-4 hours since ingestion (Garland, 1998). It has also been noted that there is a rebound effect, where symptoms are worse than baseline when the medication wears off and rebound hyperactivity and behavioral changes have also been reported (Garland, 1998). This rebound effect of medication was reported by most parents and children in the study, especially occurring in the evenings when many do not have another dose due to sleep difficulties associated with an evening dose of Ritalin®.

Three of the measures of impulsivity, self-reported venturesomeness, inability to tolerate delay ('Hungry Kevin') and responding inaccurately to non-targets on the CPT (errors of commission), failed to show differences between groups. One suggested reason for the venturesomeness results is that the scale measures adventurous activities that can be considered sensation seeking, and sensation seekers are not necessarily impulsive in nature. Despite the effect of medication being unable to be determined and the variability in dose and time since last taken, ADHD children and adolescents displayed more self-reported impulsivity, less empathy and made more risky bets than age and sex matched controls. The ADHD children also responded to fewer target trials on a continuous performance task than controls and displayed slower reaction times to non-target trials, thus suggesting inattention on the CPT rather than impulsiveness. They did demonstrate impulsive responding on 'Hungry Kevin' but so did the controls. In summary medicated children and adolescents with ADHD were more impulsive and risk-taking, less empathic and attentive than age and sex matched children and adolescents without ADHD. In addition to those findings the lack of correlations between the measures reflects previous findings and supports the view that impulsivity is multi-dimensional.

The investigation of impulsivity is continued in the next chapter beginning with an analyses of impulsivity and eating attitudes with a non-clinical population, and progressing to a clinical population of women with eating disorders.

Chapter Seven.

Eating disorders and impulsive behaviour.

The previous chapter investigated impulsivity in individuals with ADHD. In this chapter the research was extended to investigate impulsivity and self-control in women with the eating disorders anorexia nervosa and bulimia nervosa using a variety of measures. The first study in this chapter investigates eating behaviours in undergraduate students, and is used as a screen to select women to act as controls, the second study investigates impulsivity with a population of women with a clinical eating disorder.

7.0 Introduction

It has been claimed that failure to control food intake is one of society's most common self-regulatory problems (Baumeister, Heatherton & Tice,1994).The failure to regulate food intake can then become a clinical problem for some who develop the eating disorder bulimia nervosa which is characterised by uncontrolled eating binges. The eating disorder anorexia nervosa, on the other hand is associated with excessive control of food intake and could be considered to be a disorder of over regulation.

Prevalence.

The eating disorders anorexia nervosa and bulimia nervosa are psychiatric disorders that affect the lives of millions of people and their families each year. The prevalence of anorexia nervosa in females in late adolescence/early adulthood is estimated to be 0.5-1.0%, and the estimated prevalence of bulimia nervosa is higher at 1-3% of the female population in late adolescence/early adulthood (DSM-IV, 1994). However the most commonly encountered eating disorder diagnosis is subthreshold, such as DSM-IV 'eating disorder not otherwise specified'. Contrary to the popular belief that eating disorders only affect young women, an increasing number of young men are being diagnosed with eating disorders and DSM-IV cites the male rate of bulimia nervosa as approximately one tenth of the female rate. The Eating Disorder Association UK estimate that 5-10% of people with eating disorders are male. Andersen (2002) suggests that a ratio of 1:6 of male to female cases of anorexia nervosa and bulimia nervosa are seen in community based epidemiological studies, whilst 10-20% of clinical cases of anorexia nervosa are male, and that clinical cases of males with bulimia nervosa are uncommon. Theories that eating disorders are only found in Western societies also appear unfounded as anorexia has been reported in China in similar prevalence rates to those of the United Kingdom and the United States (Collier, 2000). Furthermore similar prevalence rates for anorexia nervosa (0.3%) and bulimia nervosa (3.2%) have been reported in adolescent females in Iran (Nobakth & Dezham, 2000).

Classification and diagnosis of eating disorders.

The DSM-IV (APA, 1994) contains three categories of eating disorders, anorexia nervosa, bulimia nervosa and eating disorders not otherwise specified (EDNOS). Anorexia nervosa is characterised by a refusal to maintain normal body weight for age and height, and having a body weight which is less than 85% of the body weight expected. This is normally accompanied by an intense fear of gaining weight, and a "Disturbance in the way in which one's body weight or shape is experienced..." (DSM-IV, 1994, p540). There are two subtypes of anorexia nervosa, restricting type and binge eating/purging type. The restricting type is diagnosed for those where weight loss is achieved through dieting, fasting or excessive exercise. They will not have regularly engaged in either binge eating or purging behaviours during the current episode. The binge eating/purging type is diagnosed for those who regularly engage in binge eating and/or purging during the current episode. Purging behaviours include the use of laxatives and self induced vomiting.

The mean age at onset of anorexia nervosa is 17 years although it can begin in early adolescence or childhood. The DSM-IV gives the long-term mortality rate from anorexia nervosa as over 10% of those admitted to university hospitals. A 10 year follow up study of women with anorexia nervosa found that out of 76 participants 5 (6.6%) had died. This was higher than the expected mortality rates for age and sex in the USA. Amongst surviving patients, only 23.7% had recovered, 22.4% had bulimia nervosa, 2.6% had both anorexia nervosa and bulimia nervosa and 35.5% had eating disorder not otherwise specified (Eckert, Halmi et al, 1995).

The second DSM-IV category of eating disorders is bulimia nervosa. This is characterised by binge eating and inappropriate compensatory behaviours to stop weight gain. These behaviours must occur on average once a week for 3 months. A binge eating episode is accompanied by a sense of lack of control and involves the consumption of abnormally large amounts of food usually in less than 2 hours. However "after Bulimia Nervosa has persisted for some time, individuals may report that their binge-eating episodes are no longer characterised by an acute feeling of loss of control, but rather by behavioural indicators of impaired control, such as difficulty resisting binge eating or difficulty stopping a binge once it has begun" (DSM-IV, 1994, p546). Unlike those with anorexia nervosa, individuals with bulimia nervosa are often of normal body weight. DSM-IV also contains two subtypes of bulimia nervosa, the purging type and the nonpurging type. The purging subtype is used for those who regularly engage in self-induced vomiting and misuse laxatives, diuretics or enemas. The nonpurging bulimic does not regularly engage in those purging behaviours but uses other compensatory behaviours such as exercise and fasting. Bulimia nervosa usually begins in late adolescence / early adulthood and the long term outcome is unknown. It is thought that up to half of all anorexics also suffer from bulimia and that 40% of bulimics are reported to have a history of anorexia.

The third category of eating disorders in DSM-IV Eating Disorder Not Otherwise Specified (EDNOS) is used for disorders of eating that do not meet the criteria for any specific eating disorder, sometimes called subthreshold eating disorders. This includes females who meet all the criteria for anorexia nervosa except for loss of menses, or for those whose weight is within the normal range. A diagnosis of EDNOS is also given for bulimia nervosa where the criteria are met except the compensatory behaviours do not occur twice a week or for a duration of 3 months.

The ICD-10 (International classification of diseases, World Health Organisation, 1993) classifies eating disorders into four types: anorexia nervosa, atypical anorexia nervosa, bulimia nervosa and atypical bulimia nervosa. The criteria for anorexia nervosa are similar to those of DSM-IV, including the person being at least 15% below the normal body weight for weight and height, accompanied by a body shape distortion and avoidance of "fattening foods". However there are no subcategories of restricting anorexics or bingeing/purging anorexics as in DSM-IV. ICD-10 criteria for anorexia nervosa comment that behaviours such as self-induced vomiting, purging, excessive exercise and use of appetite suppressants and/or diuretics support a diagnosis of anorexia nervosa but are not essential elements.

ICD-10 criteria for bulimia nervosa again are similar to those of DSM-IV, including the consumption of large amounts of food over a short period of time and engaging in counteracting behaviours such as vomiting, purging, periods of starvation and the use of appetite suppressants and diuretics. Again ICD-10 does not sub divide bulimia nervosa into a purging type or a non-purging type. For both atypical anorexia and atypical bulimia nervosa this diagnosis is given when some of the features of the disorder are present but overall a diagnosis is not justified.

The term anorexia nervosa was coined by Sir William Gill who was a physician at Guys Hospital London (Eating Disorder Research Unit Newsletter, 2001). The term bulimia nervosa only came into use after Russell coined it in 1979. The symptoms and disorder had appeared prior to that but under different terms such as bulimarexia, which referred to college females who binged and vomited but were not anorexic (Boskind-Lodahl & White, 1978). Russell used the term bulimia nervosa to describe low and normal weight patients with bulimic behaviours. He described it as "an ominous variant of anorexia nervosa".

Whilst eating disorders are complex multifaceted disorders and the consequence of interacting factors, impulsivity or impulse dysregulation has been one factor that has been implicated in bulimia nervosa and binge eating disorder. On the other hand individuals with anorexia nervosa are characterised by excessive self-control and rigidity.

The first study in this chapter explored eating behaviours in a non-clinical population of undergraduate students. This sample was chosen as they are of a similar age range to clinical patients with eating disorders. Two questionnaires that assess eating behaviours, The Eating Attitudes Test (EAT-26, Garner; Olmsted, Bohr & Garfinkel, 1982) and the Bulimic Inventory Test, Edinburgh (BITE) (Henderson & Freeman, 1987), were used as screening measures, as females in this age group often have high body dissatisfaction. Garner, et al., (1982) suggest that while high scores on the EAT indicate the presence of anorexic symptoms it does not suggest that they are diagnostic for anorexia nervosa in a non-clinical populations. However it may be a suitable measure with which to assess outcome in those with clinical anorexia or as a screening measure for non-clinical populations. Henderson & Freeman (1987) describe the BITE as a questionnaire for the detection and description of binge-eating. The Beck Depression Inventory (BDI) was also used to assess depression as depression is commonly found in patients with eating disorders (Bulik, 2002). Beck et al (1961) reported that the BDI was able to distinguish between those with mild, moderate and severe depression.

The second study in this chapter is with inpatients who met the diagnostic criteria for anorexia nervosa or bulimia nervosa according to ICD-10 criterion.

Again as in previous studies a variety of measures were used to assess impulsivity, these include the I-7, TPQ, Bets-16, 'Hungry Kevin' and the CPT. Most of the studies using the continuous performance test (CPT) have been confined to children or adolescents with behavioural problems or specifically ADHD. An exception was Fallgatter & Herrmann (2001) who reported that in healthy adults CPT errors of commission and omission did not correlate with self-reported I-7 impulsiveness scores. However higher impulsiveness scores were associated with shorter CPT reaction times. They do not distinguish between reaction times for hits and reaction times for errors of commission so it is unclear which reaction times are being correlated with impulsiveness. However the results do show that fast responding is associated with higher levels of impulsivity. Fahy & Eisler (1993) reported that bulimics scored significantly higher on the I-7 scales of impulsiveness and venturesomeness, than anorexics. Kleifield, Sunday, Hurt & Halmi (1993) investigated the validity of the TPQ (100 item version) for use with an eating disorder population using bulimics and subcategories of anorexia. They concluded that it was an internally consistent instrument for use with eating disorder patients. Unfortunately they did not report the scores for each of the four groups of women with eating disorders on the TPQ scales. No studies were identified which had used an operant choice paradigm with an eating disorder population, and the Bets-16 is a novel test.

The aims of the first study are to (i) investigate whether there are sex differences between males and females on the measures of impulsivity (ii)depression and (iii) eating attitudes and (iv) to screen for a sample of women to act as controls for women with eating disorders.

<u>7.1 Experiment 1. Exploring possible sex differences in impulsivity, depression and eating attitudes.</u>

This first study consisted of two stages. The first stage involved the administration of a battery of questionnaires to a large sample of undergraduate psychology students to establish whether there were differences between males and females on self-reported measures of impulsivity, eating attitudes and depression. The second stage was to recruit the participants from stage one to complete the computer tasks, 'Hungry Kevin' and the continuous performance test. The two stages were also designed to establish a group of females who did not score high on either depression, eating attitudes or bulimic behaviours, to act as the control group for the women diagnosed with an eating disorder.

7.1.1 Method

Participants.

Participants in stage one were 57 undergraduate psychology students, 11 males aged 19-49 (mean age 25.0, SD =10.25) and 46 females aged 19-41 (mean age 24.9, SD = 7.2). In stage two 39 participants from stage one took part to earn research participation credit. These were 8 males and 31 females. Age ranged from 19-49 for males (mean = 27.0. SD = 9.6) and 18-41 for females (mean = 25.4, SD = 7.7).

7.1.2 Apparatus

The continuous performance task and ‘Hungry Kevin' were presented on, and data recorded by, a Phoenix NoteBIOS 4.0 multimedia notebook. In the operant choice paradigm, ‘Hungry Kevin', the w key of the keyboard was covered with a white sticker and functioned as the white key while the b key was covered with a blue sticker and functioned as the blue key.

7.1.3 Materials.

Questionnaires:

The I-7 (Eysenck et al., 1985). Contains three scales, impulsiveness, venturesomeness and empathy. High scores reflect higher levels of the behaviour. Refer to chapter 3 for further details.

The Tri-dimensional questionnaire- TPQ-54 item version. (Heath et al., 1994). Contains three scales novelty seeking (NS), harm avoidance (HA) and reward dependence (RD). Higher scores reflect higher levels of each trait. Refer to chapter 3 for further details.

The Bets-16. Refer to chapter 4.

The Eating Attitudes Test - EAT-26 (Garner et al., 1982).

This is a 26 item questionnaire that contains three scales – dieting, bulimia and food preoccupation and oral control. It is a self report screening instrument for detecting previously undiagnosed cases of anorexia nervosa. The questions deal with feelings and behaviours associated with anorexia. Items are scored on a Likert scale from 0-3. Higher scores reflect more disturbance. The cut-off score of 20 is given by the authors as being the point which successfully identified 84% of the sample as belonging to an anorexic group or the control group. Garner et al (1982) reported mean scores for a clinical group of anorexics as 36.1± 17.9 and for female controls as 9.9 ± 9.2.

The Bulimic Inventory Edinburgh - BITE (Henderson & Freeman, 1987).

This is a 33 item questionnaire to assess bulimic behaviours. The BITE contains two scales the symptom scale and the severity scale; 30 items make up the symptom scale and 3 items (numbers 6, 7 &27) the severity score. The severity scale is scored by adding the numbers corresponding to the responses which ask about the frequency of certain behaviours.

The symptom scale is scored out of a maximum of 30. The authors suggest that a symptom score greater than 20 indicates the presence of binge-eating and highly disordered eating behaviour. Scores of 10-19 indicate unusual eating behaviours and scores of 0-10 fall within the normal range. A score of 5 or greater on the severity scale is considered to be clinically significant. Scores from a control group of females reported were: symptom scale mean = 2.94, s.d. = 2.94 and severity scale mean = 0.44, s.d=0.29. Henderson & Freeman reported that the BITE has good internal reliability, alpha=0.96 for the symptom scale and 0.62 for the severity scale. The BITE also demonstrated good test-retest reliability after 1 week with women with bulimia nervosa (R=0.65) and controls (R=0.86).

The Beck Depression Inventory - BDI (Beck, et al., 1961).

This is a 21 item questionnaire which asks about feelings over the past week. Each item is scored on a four point scale from 0-3 and higher scores reflect greater severity of depression. Internal consistency of 0.86 was reported. Beck et al reported that it is able to distinguish between those with no, mild, moderate and severe depression.

Computer Tasks.

Hungry Kevin.

In this operant choice paradigm participants made choices which affected the amount of time that they played a video game for and the length of time that they had to wait before the game began after being interrupted.

The contingencies operating on each choice are shown in table 7.1.1. The white button always operated the impulsive choice contingency. Both choice schedules had a 6 second post reinforcement delay. What differed between the schedules was the amount of pre- reinforcement delay and the amount of reinforcement, i.e. amount of access to playing the game. Reinforcement densities were designed to be equal between the two choice schedules.

Table 7.1.1 Contingencies of reinforcement operating under the impulsive choice (white button) and the self-controlled choice (blue button) for 'Hungry Kevin'.

Operant Response Button	Pre Reinforcement Delay	Reinforcement	Post Reinforcement Delay
White	0 seconds	10 seconds	6 seconds
Blue	18 seconds	40 seconds	6 seconds

The Continuous performance task. CPT. (Conners, 1995)

The AX paradigm was used in this study. Participants were to respond to a target stimulus, by pressing the space bar. The target stimulus was the series of letters AX. Participants were required to respond to the letter X, but only if it had been preceded by the letter A. There were 4 blocks of trials and each block contained 100 trials per block. For each 100 trials/block 10 of the trials were target trials giving a total of 40 target trials. The inter stimulus interval was 1.5 seconds.

7.1.4 Procedure.

There were two stages to the present study. In stage one participants completed the battery of questionnaires in small groups of approximately 10 as part of a research methods practical. This included all questionnaires except the Bets-16, which was administered in stage two. The questionnaires were given to participants, along with an information sheet and consent form. After participants had read the information sheet they were instructed to ask if they had any questions, and those who agreed to take part were to complete the consent form and then work quietly and independently through the questionnaires. The order of completion was decided by the participants.

Stage two of the study was advertised on the research participation board and participants signed up for a time and were then seen individually for a further 30 minutes to complete the two computer tasks, 'Hungry Kevin' and the CPT, and the Bets-16. After being further informed of the second part of the study participants signed a consent form for stage two and were then administered the tasks. In stage two Hungry Kevin was always administered first followed by the CPT, and the Bets-16 was completed last. After completion of the Bets participants were debriefed as to the nature of the study and given an opportunity to ask questions.

7.1.5 Results

Stage one. Sex differences and correlations between questionnaires.

The scores between males and females were investigated to assess whether there were any sex differences in impulsivity, depression scores, eating attitudes or bulimic behaviours. If no differences were found the correlation between the measures was investigated collapsing male and female data. Independent t-tests were used to assess differences between males and females.

The mean age was not significantly different between males and females ($t = -0.33$, $df = 55$, $p = 0.97$)..

I-7- Impulsiveness, venturesomeness and empathy.

As can be seen below in table 7.1.2 although males had a tendency to score higher than females on impulsiveness ($t = -0.59$, $df = 55$, $p = 0.56$) and venturesomeness ($t = -1.25$, $df = 55$, 0.22) there were no significant differences on either scale. There were also no significant difference between males and females on empathy ($t = 1.85$, $df = 55$, $p = 0.07$).

Mean scores and standard deviations for the three I-7 scales, the three TPQ scales, Beck Depression Inventory, and eating behaviours as assessed by the EAT-26 and the BITE are presented in table 7.1.2.

Table 7.1.2. Mean and standard deviation scores for males and females on the I-7 scales (I,V,E), BDI, BITE, EAT-26 and TPQ scales (HA,NS,RD).

	Sex			
	Males		Females	
	Mean	SD	Mean	SD
N	11		46	
I	9.73	4.6	8.85	4.4
V	10.6	3.6	9.4	3.3
E	12.6	2.9	14.5	3.2
BDI	5.2	5.8	5.6	4.9
BITE symptom	4.0	5.7	6.5	6.2
BITE severity	1.4	2.0	1.1	1.7
N	11		45	
HA	6.0	4.5	7.6	4.7
NS	11.3	3.7	10.3	3.8
RD	9.7	3.4	12.3*	2.9
EAT-26	4.6	10.3	6.5	7.1

* $p<0.05$. I = impulsiveness, V = venturesomeness, E = empathy, BDI= Beck Depression Inventory, HA= Harm avoidance, NS= novelty seeking, RD= reward dependence.

TPQ – harm avoidance, novelty seeking and reward dependence..

There were no significant differences between males and females on harm avoidance ($t = 1.05$, $df = 54$, $p=0.30$) or novelty seeking ($t = -0.78$, $df=54$, $p=0.44$). Females had significantly higher reward dependence scores than males ($t = 2.38$, $df = 54$, $p = 0.02$).

BDI

Self-reported depression scores were low for both males and females and were not significantly different, ($t = 0.25$, $df=55$, $p=0.80$).

EAT-26 and BITE

Males and females both scored low on eating attitudes and bulimic behaviours and there were no significant differences between groups on EAT-26 scores ($t = 0.75$, $df = 54$, $p=0.56$), BITE symptom scores ($t = 1.24$, $df = 55$, $p=0.22$) or BITE severity scores ($t = -0.40$, $df = 55$, $p=0.69$).

With the exception of TPQ reward dependence, there were no significant differences between males and females on the measures. Therefore correlation coefficients were computed for the whole group, males and females. Correlation coefficients between the measures are presented in table 7.1.3. TPQ reward dependence does not appear in the table as there were no significant correlations between reward dependence and any of the other scales.

Table 7.1.3. Correlation coefficients between the scales from stage one.

N = 56

	HA	NS	I	V	E	BDI	EAT	SYM
NS	-0.44**							
I	-0.31*	0.71**						
V	-0.37*	0.48**	0.25					
E	0.31*	-0.18	-0.1	-0.22				
BDI	0.45**	-0.16	-.13	-.27*	.09			
EAT	0.39**	-0.02	-.16	-.03	.26*	.30*		
SYM	0.41**	0.08	-.09	-.10	.23	.42**	.63**	
SEV	0.09	0.05	.03	-.07	.03	.19	.46**	.62**

* $p < 0.05$, ** $p < 0.01$

HA (TPQ harm avoidance), NS (TPQ novelty seeking), I (I-7 impulsiveness), V (I-7 venturesomeness), E (I-7 empathy), EAT (Eating Attitudes Test –26 item), SYM and SEV (Bulimic Inventory Test –Edinburgh, symptom and severity scales), BDI (Beck Depression Inventory).

As can be seen from table 7.1.3 a negative correlation was found between harm avoidance and each of novelty seeking, impulsiveness and venturesomeness. Low harm avoidant behaviour was associated with high novelty seeking behaviour, high impulsiveness and high venturesomeness. Harm avoidance also correlated positively with empathy, depression scores (BDI), eating attitudes and symptom of the BITE.

In addition to the negative correlation with harm avoidance, TPQ novelty seeking also correlated positively with I-7 impulsiveness and venturesomeness scores.

Eating attitude scores correlated positively with both BITE symptom and severity scores ($p < 0.01$) and there was a positive correlation between BITE symptom and BITE severity scores.

With the exception of the correlation coefficient between EAT-26 and BITE symptom, and BITE symptom and severity, all significant coefficients were low to moderate.

Stage two results: sex differences in 'Hungry Kevin', CPT and Bets-16.

As noted above stage two was conducted to recruit participants who had taken part in stage one to complete the two computer games, 'Hungry Kevin' and the continuous performance task, and the Bets-16. 68.4% of those who participated in stage one also participated in stage two. From those who had participated in both stages controls were to be selected for the eating disorder patients. A larger sample was recruited so that those who had scored high on the BITE, the EAT-26 and/or the BDI, thus exhibiting disordered eating, bulimic behaviours or high levels of self-reported depression could be excluded as control participants.

Descriptive statistics, means and standard deviations, for males and females are given in table 7.1.4 for the CPT errors of omission and errors of commission, reaction times for errors of commission and reaction time to targets (hits), 'Hungry Kevin' percent of impulsive responding across the session, latency to respond on 'Hungry Kevin free choice trials and number of risky bets chosen on Bets-16.

Table 7.1.4. Means and standard deviations for males and females for 'Hungry Kevin' percent of impulsive choices, latency to respond, CPT error and reaction time scores.

	Females N = 31		Males N = 8	
	Mean	SD	Mean	SD
Hungry Kevin	69.0	31.1	80.4	18.2
HK latency	512.5	78.1	537.9	53.9
Omission errors	0.56	1.4	0.0	0.0
Commission errors	0.25	0.40	0.29	0.29
Hit reaction time (RT)	450.9	107.5	413.6	73.0
Commission RT†	640.2	212.7	381.0	174.4
Bets-16	4.5	4.7	4.0	2.9

† n = 14 for females and n=5 for males. Reaction times for errors of commission, hit RT and latency to respond on 'Hungry Kevin' free choice trials are given in milliseconds.

As shown in table 7.1.4 males had a greater tendency to choose the smaller more immediate reinforcer than females in 'Hungry Kevin', however this difference was not statistically significant (U= 111.0. n =39, p=0.67) and 'Hungry Kevin latency to respond on free choice trials did not differ significantly between males and females (U = 99.5, n=39, p=0.40).

There were no statistically significant differences between males and females on any of the CPT scores: errors of omission, errors of commission, hit reaction time or errors of commission reaction time (all p>0.05). The number of risky bets chosen on Bets-16 was not significantly different between males and females ($U = 124.00$, $n = 39$, $p = 1.0$). The number of males in the study was however very small.

As the analysis revealed no differences between males and females in scores a correlational analysis was carried out between the measures from stage one and stage two. There was a positive correlation between Bets-16 and venturesomeness ($rho = 0.38$, $N = 39$, $p < 0.05$). Bets-16 also correlated negatively with CPT errors of commission ($rho = -0.41$, $N = 39$, $p = 0.006$), CPT commission reaction time ($rho = -0.41$, $N = 39$, $p = 0.01$), and BDI ($rho = -0.34$, $N = 39$, $p = 0.035$).

There were no significant correlations between any of the other measures from stage two, including the proportion of impulsive choices on 'Hungry Kevin' and CPT errors of omission.

In summary these tests from the two stages, with the exception of TPQ reward dependence, failed to reveal any significant differences between males and females. However the number of males in both stages was low ($n = 11$ and $n = 8$). None the less not one of the non-significant comparisons even approached significance.

7.1.6 Discussion.

Stage 1

The majority of the sample (80.7%) were female. There was no difference in the age of the males and females. Males and females only differed significantly on one of the ten measures, this being TPQ reward dependence which females scored higher on. This is line with the findings of Heath et al. (1994) who reported that women scored significantly higher than men on reward dependence. Heath et al. (1994) also reported that women scored significantly higher than men on harm avoidance. Cloninger et al. (1991) also found that women scored higher than men on reward dependence using the 100 item version of the TPQ. Although females had a tendency to score higher than males on harm avoidance there was no significant difference between the two groups. The failure to find no differences in scores between males and females on harm avoidance is not in line with Heath et al. (1994) or Cloninger et al (1991) who both reported that females had higher harm avoidance scores than males. The mean age of Heath et al. participants was older than the current sample, however they do no give age for each sex. The findings on reward dependence indicate that women seek rewarding experiences more than men do.

Although males tended to score higher than females on both the impulsiveness and venturesomeness scales of the I-7 and lower on empathy there were no significant sex differences on either scale. The scores on all three scales for both males and females were within one standard deviation of the mean scores reported by Eysenck et al. (1985) from a comparable age range. Although Eysenck et al (1985) do not report any statistical analysis between males and females they do report that females had higher mean scores on empathy and lower mean score on venturesomeness than males.

Males and females were not different in terms of depression scores, eating attitudes and bulimic behaviours. Scores for both sexes were in the low range indicating low depression, normal attitudes to eating and low levels of engaging in bulimic behaviours. The mean eating attitudes scores for females were lower than that reported by Garner et al. (1982) for control females, but within one standard deviation of their score. Both males and females, whilst scoring low on BITE symptom and severity had higher scores on both measures compared with the means reported for control females by Henderson & Freeman (1987).

TPQ harm avoidance correlated negatively with novelty seeking, impulsiveness and venturesomeness. These findings would be expected as high harm avoidant behaviour is associated with the tendency to avoid punishment and novelty and to inhibit "...exploration of unfamiliar or uncertain situations..." (Cloninger, 1987a, p575). Therefore those who score low on harm avoidance are not engaging in the avoidance of aversive events. On the other hand novelty seeking is associated with engaging in "...exploratory activity in pursuit of potential rewards as well as active avoidance of monotony..." (p575), and impulsiveness is concerned with behaviour that fails to look ahead to the consequences of behaviour, whilst venturesomeness assesses risk taking where an individual is aware of the risks. These correlations indicate an outgoing sensation seeking person who seeks novel experiences and does not actively avoid punishment or aversive situations.

Harm avoidance also correlated positively with depression scores (BDI), EAT-26 scores and symptom of the BITE which assesses bulimic behaviours, so high harm avoidance behaviours were associated with high levels of self reported depression, high disordered eating attitudes and high levels of engaging in bulimic behaviours. These correlations indicate that unhealthy eating attitudes and behaviours are associated with depression and behaviour which avoids punishment and unfamiliar situations. The link between disordered eating and depression is well established (Bulik, 2002), but their association with harm avoidance might seem surprising, as unhealthy eating attitudes and behaviours are associated with physical and psychological self-harm. This may indicate that those with unhealthy eating attitudes are more concerned with the perceived harm (or punishment) that they associate with weight gain, than with the harm which results from unhealthy eating. For them to gain weight or move further away from their desired body image may be perceived more harmful and punishing, than the harm done to their health through either starvation and/or engaging in bulimic behaviours. Whilst they do not avoid harm associated with abnormal eating, and people with clinically diagnosed anorexia nervosa do not perceive anything wrong with their weight (DSM-IV), they may seek to avoid harm in other situations and areas of their life, hence the association with high harm avoidance behaviour and eating attitudes and behaviours. One plausible explanation for the positive correlation with harm avoidance and high level of self-reported depression could be that those with depression seek to avoid harmful, unfamiliar and uncertain situations due to their depressed state whereas people who are not depressed may be in a better position to tolerate harm and unfamiliar situations if it potentially results in positive and new experiences.

High scores on novelty seeking were associated with high scores on both impulsiveness and venturesomeness. This is expected as TPQ novelty seeking contains an impulsivity subscale, and novelty seeking behaviour involves a person taking risks. Impulsiveness assesses the risk taking behaviour engaged in on the spur of the moment with no thought of the consequences of behaviour, and venturesomeness is risk taking behaviour where the person is considered to be aware of the risks and engages in the behaviour for the thrill (Eysenck, S.B.G., 1991).

Other significant correlations were between eating attitude scores and bulimic behaviours. This is expected as bulimics also have disordered eating and control their weight through a combination of fasting, and then when the restraint breaks down they engage in bingeing behaviour and for some this is followed by purging behaviours. Eating attitudes also correlated positively with empathy scores, indicating that those who are low on empathy do not have disordered eating attitudes.

Overall significant correlations were found where expected, with some unexpected findings, and the coefficients were generally moderate.

Stage two discussion.

Thirty-nine of the fifty-seven participants from stage one also took part at stage two. This enabled enough females to be recruited to act as controls for the eating disorder study, excluding those who had scored high on either of the BITE, EAT or BDI.

Although there was not a statistically significant difference, males had a greater tendency to make more impulsive choices on 'Hungry Kevin' than females, however both groups displayed impulsive behaviour displaying a preference for the smaller more immediate reinforcer across the session. As in experiment 6.2 the two measures derived from 'Hungry Kevin' (latency to respond and impulsive choice responding) did not correlate with any of the other measures.

As in experiment 4.1 there were no differences between males and females on the number of risky bets chosen on the Bets-16. The mean scores for females is also comparable to those reported in table 4.1.1, and mean scores for males were slightly lower but still within the range reported previously.

Once again a low but positive association was found between Bets-16 and venturesomeness. As both are considered to be measuring risk taking behaviour, although in different domains, this was not an unexpected finding. The correlation also supports the Bets-16 test as a risk taking measure as venturesomeness measures risk taking behaviour where an individual is considered to be aware of the risks involved with their behaviour. Although the negative correlation between Bets-16 and CPT errors of commission initially does seem surprising, as a positive association would be expected between risk taking and a measure of impulsivity, as previously mentioned it may be that the types of errors of commission that some people are making are more indicative of inattention rather than impulsive behaviour. However if this was the situation then inattentive people should also make more errors of omission and Bets-16 did not correlate with errors of omission. The negative correlation between Bets-16 and CPT commission reaction time, demonstrates that those who make more risky bets and are considered to be risk takers are also prone to fast responses. Fast responding is typically associated with impulsive behaviour. However neither of the reaction times correlated significantly with self-reported impulsivity or impulsive responding on 'Hungry Kevin'. These results therefore further demonstrate both low significant correlations and non-significant correlations between measures of impulsivity. Where past studies have reported a correlation within behavioural measures this was not found in the current study (Parker et al., 1993).

Sixteen females who had taken part in both stages of the study were selected, if they scored lower than 10 on both the EAT-26 and BITE symptom, less than 5 on the BITE severity, to act as a control group for the females with a clinical eating disorder. These cut off figures were taken from what was reported as normal attitudes on the BITE, equal to or below the control mean on the EAT-26 reported by Garner et al (1984). This figure for the EAT-26 was taken rather than scores within one standard deviation of the mean score as the mean reported by Garner et al (1984) was 9.9 with a standard deviation of 9.2. and they report that a cut off above 20 identifies 84% of anorexics. It was felt that those who scored higher than 10 would be exhibiting unhealthy eating behaviours.

7.2. Experiment II. Piloting the measures with an eating disorder population.

7.2.0 Introduction.

The main study (7.3) was carried out to investigate differences on impulsivity between a group who are considered to be self-controlled, women with restricting anorexia nervosa, and a group who are considered to have problems with control and engage in impulsive behaviour, women with bulimia nervosa. A third group of women who were screened to eliminate those with disordered eating behaviour and attitudes, and/or high levels of self-reported depression was also included. As mentioned in chapter 2, individuals with bulimia nervosa have been found to have higher levels of impulsive behaviour than those with anorexia. There also seems to be a difference between the subgroups of anorexics, with those with bulimic behaviours scoring higher on impulsivity than restricting anorexics. Furthermore bulimia is associated with a sense of lack of control surrounding eating. The measures were first piloted on 8 women who were recruited from an eating disorder unit in Kent, to test whether the tasks and the length of time for participation was suitable for the population chosen.

7.2.1 Method

Participants.

Eight females participated in the pilot study. They were aged 15-42 (mean 28.8 ± 11.4). All eight females had a diagnosis of anorexia nervosa according to ICD-10 criteria. All diagnoses were given by the Eating Disorder Unit's psychiatrist. Five of the participants were inpatients at an Eating Disorder Unit in Kent and the other three anorexics were attending the Eating Disorder Unit's day patient programme.

Method

Materials

I-7. See experiment 7.1 or refer to chapter 3.

Bets-16. Refer to chapter 4.

Hungry Kevin. Condition 2 was used with session length set at the equivalent of 20 free choices of the larger later reinforcer. This was 800 seconds of access to reinforcement. Contingencies of reinforcement are the same as those used in stage two of experiment 7.1.

Continuous Performance Test-CPT. (Conners, 1995).

Refer to chapter 3 for full details.

The X only version was used, as outlined in experiment 6.1. Participants responded to the letter X by pressing the space bar. Withholding of a response was required for all other stimuli.

Beck Depression Scores-BDI. Refer to section 7.1.2

All new patients to the Eating Disorder Unit were being given the BDI by the unit's clinical psychologist, within two weeks of admission as an inpatient or upon entering the day programme. It was agreed that these scores would be supplied by the clinical psychologist to save repetition for the patients.

<u>Procedure.</u>

Permission for the study had been obtained by the Local Research Ethics Committee, and prior agreement made with the eating disorder unit. The inpatients were approached by the nursing staff and given an information sheet about the study. If they agreed to take part then a time was arranged with the unit to see the patient. All patients were seen in an office at the unit on a one to one basis. A member of nursing staff escorted the patient to the office at the time arranged and the study was explained. Permission to access their records held at the unit was sought and if they agreed to take part in the study and for their records to be accessed a consent form was signed. The order of completing the tasks was randomised for each patient. The procedure was the same for the daypatients. Following completion of the tasks the patients were all debriefed and were asked not to discuss the aims of the study with their fellow patients who were yet to take part or new patients to the unit.

7.2.2 Results and Discussion.

Due to staff changes at the Eating disorder unit Beck Depression scores were never obtained for these patients.

The nursing staff at the eating disorder unit confirmed that the inpatients had more severe eating disorder and symptoms than the day-patients. It was not uncommon for day patients to have previously been inpatients. The inpatients were admitted for re-feeding and therapy. The sample size was too small for statistical analysis to be carried out on the scores between anorexic inpatients and day patients. However comparisons using descriptive statistics (see table 7.2.1) indicate a large overlap between the scores of both groups on all measures.

Median, minimum and maximum scores for the 5 anorexic inpatients and the 3 anorexic day patients are presented in table 7.2.1.

As can be seen in table 7.2.1 the median age of the five inpatients was slightly younger than for the three day-patients. The range of ages was similar although the minimum age was lower for the inpatients.

Table 7.2.1. Median, minimum and maximum scores for the inpatients and day patients for age, the I-7 scales (I,V,E), Bets-16 number of risky bets chosen, 'Hungry Kevin' and the CPT.

	Inpatients n = 5			Day patients n =3		
	median	Min	max	median	min	max
Age	23.0	15.0	42.0	38.0	18.0	42.0
I	3.0	2	14	2.0	2	12
V	12.0	0	15	4.0	0	9
E	17.0	9	19	15.0	14	17
Bets-16	1.0	0	3	2.0	0	7
HK	24.0	13.0	97.0	0.0	0.0	50.0
HK laten.	467.8	395.7	573.2	577.5	478.7	586.0
Omission	1.0	0	1	3.0	1	3
Comm.	3.0	0	3	1.0	0	2
Hit RT	336.0	329.0	421.7	406.6	375.4	442.9
Comm. RT	240.0	0	270.0	240.0	0	330.0

HK = Hungry Kevin percent of impulsive choices, HK laten. = latency to respond on free choice trials, Omission = CPT errors of omission, comm. = CPT errors of commission, Hit RT = reaction time on CPT target trials, Comm RT = errors of commission reaction time.

There were no difficulties with the pencil and paper tasks and participants completed these quickly and as instructed. The CPT was reported to be boring by many participants. Many participants reported that 'Hungry Kevin' went on for too long, whilst others enjoyed it and felt it was not too long. It was however decided for the main study (experiment 7.3) to reduce 'Hungry Kevin' reinforcement time to the equivalent of 10 free choices of the larger later reinforcer operating under the blue button. This had been done with the adolescents and children with ADHD and no information was lost by the reduction.

The short version of the CPT was not long enough to yield sufficient information and with the reduction in the length of the session due to reducing the amount of time taken to complete 'Hungry Kevin' it was decided to use the AX version of the CPT for the main study. The AX version of the CPT requires participants to detect a target stimulus which has been primed and this was therefore considered a better test of attention and impulsivity.

7.3. Experiment III. Impulsivity and eating disorders.

From the pilot study the measures tested in experiment 7.2 appeared to be suitable, with minor modifications, for use with a population of women with eating disorders. These modifications were to reduce the length of 'Hungry Kevin' and to use the AX version of the continuous performance task for the main study.

7.3.1 Method.

Participants.

Following Local Research Ethics approval twenty-five women with eating disorders were recruited from an Eating Disorder Unit in the Kent region. All diagnoses were made by the unit's psychiatrist according to ICD-10 (WHO) criteria. Participants consisted of 15 inpatients diagnosed with anorexia nervosa, 5 outpatients with bulimia nervosa and 5 outpatients with anorexia nervosa. One of the anorexic inpatients had a diagnosis of atypical anorexia nervosa and one of the bulimic outpatients had a diagnosis of atypical bulimia nervosa. The women with eating disorders were recruited over a 14 month period. Control participants were 16 age-matched women from experiment 7.1 stage one and two, who were screened using the BITE and the EAT for disordered eating attitudes and bulimic behaviours. Those who scored less than 10 on each measure were included. Control participants were also screened for depression using the BDI. Details on age for each of the four groups of participants are presented in table 7.3.1.

Table 7.3.1 Mean, standard deviation, minimum and maximum age scores, in years, for the three patient groups and controls.

	N	min	max	mean	SD
AN inpatients	15	15	46	27.9	9.9
AN outpatients	5	22	34	34.0	4.5
BN outpatients	5	27	39	33.0	4.5
Controls	16	18	41	28.4	8.3

There were no significant differences in the mean age between the anorexic inpatients and the control group ($t = 0.13$, $df = 29$, $p > 0.05$, two-tailed).

Education levels were not obtained from the patient groups. All controls were undergraduate university students. Occupation was obtained from the patient groups and the occupation varied from students, shop assistants and secretaries to a molecular biologist.

Apparatus

The continuous performance task and 'Hungry Kevin' were presented on, and data recorded by, a Phoenix NoteBIOS 4.0 multimedia notebook. In the operant choice paradigm, 'Hungry Kevin', the W key of the keyboard was covered with a white sticker and functioned as the white key while the B key was covered with a blue sticker and functioned as the blue key.

Materials.

Bets-16. Refer to chapter 4.

I-7. Refer to chapter 3.

BDI. See section 7.1

Hungry Kevin. Refer to chapter 3.

Condition 2 was used as in section 7.1. The total amount of reinforcement received across the session was reduced to the equivalent of 10 free choices of the larger later reinforcer. This gave a total of 400 seconds of reinforcement for the session.

Continuous Performance Task-CPT (Conners, 1995).

Refer to chapter 3. The AX version was used in this study.

Procedure.

Participants from all three patient groups were seen individually in an office at the eating disorder unit. The inpatients were approached by a staff nurse and given an information sheet and asked if they would like to take part in some research that was being conducted by a researcher from the University of Greenwich. The outpatients were sent a letter, by the Eating Disorder Unit with their appointment, outlining the research and responded indicating whether they would like to take part or not when they confirmed their appointment. Those who had responded indicating that they would like to take part in the study were then sent a letter by the researcher with more information about the study and suggesting that they be seen after their appointment at the Unit. Those who agreed to take part were then seen. The control participants were recruited through the University of Greenwich psychology research participation scheme. They were selected from the 39 who had completed both stage one and two in experiment 7.1.

It took approximately one hour for the patient participants to complete the tasks and they were completed in one session. It took the control group approximately 1-1½ hours to complete the tasks and they were tested over two sessions. All participants were debriefed upon completion, thanked for their time and requested not to discuss the study with either their colleagues or fellow patients who were yet to take part.

7.3.2. Results.

Homogeneity of variance was assessed using Shapiro-Wilks and where homogeneity of variance was not found, as indicated by a significant Shapiro-Wilks test, then non-parametric tests were used. Group differences were only assessed between the anorexic inpatients and the controls, due to the small sample size of anorexic outpatients and bulimic outpatients.

Two of the anorexic inpatients were sectioned under the mental health act and two of the inpatients were taking medication. Chlorpromazine was taken by one patient who had been sectioned under the mental health act and metazapam was taken by another inpatient. Two of the anorexic outpatients were prescribed prozac and the outpatient with atypical bulimia nervosa was taking fluoxetine.

The length of time between admission and testing for the inpatients ranged from one week to 6 weeks. The two patients sectioned under the mental health act had been inpatients in another hospital prior to admission to the Eating Disorder Unit. Their inpatient stay elsewhere had been 10 months for one patient and 3 months for the other. All the bulimic outpatients and the anorexic outpatients were new referrals and were seen either on the day of their first consultation with the psychiatrist or on the day of their follow up appointment with the dietician or the occupational therapist.

Anorexic and bulimic outpatient results.

Descriptive statistics for the BDI, I-7 scales and Bets-16 from the five anorexic outpatients and the five bulimic outpatients are presented in table 7.3.2.

As can be seen in table 7.3.2 I-7 empathy scores were similar between the two groups of outpatients. There was a tendency for the anorexic outpatients to score higher on venturesomeness and impulsiveness than the bulimic outpatients. The anorexic outpatients also tended to have higher Beck Depression scores than the bulimic outpatients. The range in scores on Bets-16 was similar between the anorexic and bulimic outpatients, as were mean scores.

Descriptive statistics for 'Hungry Kevin' and the continuous performance test are presented in table 7.3.3 for the anorexic and bulimic outpatients.

Median scores for percent of impulsive choices on 'Hungry Kevin' were similar between the two groups although there was much more variability in the scores of the bulimics. CPT hit reaction time showed similar range of scores between the two groups. CPT errors of commission reaction times have reduced numbers of participants as not all participants made errors of commission and therefore did not have a score for that variable.

Table 7.3.2. Median, minimum, maximum, mean and standard deviation scores for the BDI, I-7 scales (I,V,E) and Bets-16, number of risky bets chosen, for the anorexic and bulimic outpatients.

	Anorexic outpatients n = 5					Bulimic outpatients n = 5				
	median	min	max	mean	SD	median	min	max	mean	SD
BDI	35.0	11	46	30.2	14.7	27.0	9	39	25.5	12.5
I	8.0	4	16	9.0	5.3	7.0	2	14	7.2	4.7
V	11.0	2	13	9.5	5.1	9.0	2	10	7.4	3.2
E	14.0	12	17	14.3	2.1	15.0	10	16	14.2	2.5
Bets-16	3.0	0	9	3.8	4.1	4.0	0	8	3.6	3.6

BDI = Beck Depression Inventory, I= I-7 impulsiveness, V = I-7 venturesomeness, E = I-7 empathy.

Table 7.3.3. Median, minimum, maximum, mean and standard deviation scores on 'Hungry Kevin' and the CPT scores for the anorexic and bulimic outpatients. Reaction times and HK latency scores are in milliseconds.

	Anorexic outpatients n = 5					Bulimic outpatients n = 5				
	median	min	max	mean	SD	Median	min	max	mean	SD
HK	85.0	77.0	97.0	87.0	8.1	81.0	16.0	97.0	66.6	34.4
HK latency	442.7	330.0	543.0	437.5	76.4	516.0	325.0	608.0	491.1	104.3
Omission	0.0	0.0	5.0	1.7	2.4	0.0	0.0	0.0	0.0	0.0
Commiss	0.3	0.0	3.0	0.78	1.4	0.0	0.0	7.0	1.3	3.0
Hit RT	502.3	331.7	565.4	465.7	101.9	474.5	332.3	570.5	472.2	88.0
Comm. RT	550.0[a]	110.0	600.0	420.0	269.6	272.0[b]	272.0	272.0	272.0	-----

HK = Hungry Kevin percent of impulsive choices, omission = CPT errors of omission, comiss = CPT errors of commission, Hit RT = CPT hit reaction time, Comm. RT = CPT errors of commission reaction time. a n = 3 , b n = 1

Comaparisons between anorexic inpatients and controls.

As can be seen in table 7.3.4 the anorexic inpatients scored significantly lower on both impulsiveness ($t = 2.24$, $df = 29$, $p = 0.033$, two-tailed) and venturesomeness ($t=2.58$, $df = 29$, $p = 0.015$ two-tailed) than the controls. As with the mean scores the median scores for impulsiveness and venturesomeness were higher for the controls compared with the anorexic inpatients and there was more variability in impulsiveness scores for the controls. Although the anorexic group had a tendency to score higher on empathy the difference was not statistically significant ($t = -1.26$, $df=29$, $p = 0.22$, two-tailed).

Whilst the anorexic group chose fewer risky bets in the Bets-16 test than the control group there was not a significant difference between the two groups on the number of risky bets chosen ($U = 103$, $n=31$, $p >0.05$).

Mean scores for the control group and anorexic inpatients for the BDI, I-7 scales impulsiveness (I), venturesomeness (V) , empathy (E), plus the Bets-16 scores are presented on the next page in table 7.3.4.

Table 7.3.4. Median, minimum, maximum, mean and standard deviation scores for the BDI, I-7 scales (I,V,E) and Bets-16 number of risky bets chosen for the anorexic inpatients and control groups.

	Controls n = 16					Anorexic Patients n = 15				
	median	Min	max	Mean	SD	median	Min	max	mean	SD
BDI	4.0	0	23	5.8	5.9	18.0	9	47	23.2***	14.4
Impulsiveness	10.5	2	19	10.50	4.87	7.0	1	12	7.07*	3.49
Venturesome	10.0	2	13	8.50	3.74	5.0	1	13	5.33**	3.04
Empathy	14.5	10	19	14.19	2.74	16.0	9	18	15.40	2.61
Bets-16	3.5	0	16	5.56	5.73	2.0	0	16	3.73	4.54

p<0.05, ** p<0.02, *** p<0.002. BDI = Beck Depression Inventory, Venturesome = venturesomeness.

Beck Depression Inventory (BDI) scores were missing for 4 of the anorexic inpatient group. The anorexic group scored significantly higher on the BDI than the control group ($U = 13.0$, $n = 27$, $p < 0.001$). As can be seen in table 7.3.4 the range of scores on the BDI was greater for the anorexic group, 38 compared with a range of 23 for the controls. Whereas the minimum score for the anorexic group was 9, 81.3% (13) of the control group had scores less than 9.

The group means for scores on the computer tasks, 'Hungry Kevin' and the CPT, for the anorexic inpatients and controls are presented in table 7.3.5. As with the anorexic and bulimic outpatients there were reduced numbers of participants for errors of commission reaction times as not all participants made errors of commission. There was a significant difference on CPT errors of commission between the two groups with the anorexic group making more errors ($U = 57.0$, $n = 31$, $p < 0.05$). Although the anorexic group also had a tendency to make more errors of omission than the controls this difference was not significant ($U = 111.0$, $n = 31$, $p > 0.05$).

The anorexics had a tendency to respond quicker to targets than the controls but this was not significant ($t = 0.95$, $df = 29$, $p > 0.05$, two-tailed). The same trend was seen for errors of commission reaction times with the anorexics being faster to respond to non-targets and this difference was significant ($U = 9.5$, $n = 17$, $p < 0.02$, two-tailed).

Table 7.3.5. Median, minimum, maximum, mean and standard deviation scores for the anorexic inpatients and control groups on 'Hungry Kevin' and the CPT scores. Reaction times and HK latency scores are in milliseconds.

	Controls n = 16					Anorexic inpatients n = 15				
	Median	min	max	mean	SD	median	min	max	mean	SD
HK	83.5	0.0	97.0	65.0	37.5	40.0	0.0	97.0	48.8	36.7
HK latency	534	286	625	517.6	89.8	491	336	677	485.4	88.6
Omission	0.0	0	5	0.28	0.5	0.0	0	13	1.93	2.5
Commiss	0.0	0	2	0.94	1.8	1.7	0	8	1.63*	3.5
Hit RT	406	278	709	432.6	115.6	400	285	521	400.3	65.7
Comm. RT	577[a]	420	718	557.2[a]	112.7	330[b]	190	610	365.8 [b]*	133.2

* $p < 0.05$ anorexics vs controls. a: n =6, b: n = 11.

HK = Hungry Kevin percent of impulsive choices; omission = CPT errors of omission, comiss = CPT errors of commission, Hit RT = CPT hit reaction time, Comm. RT = CPT errors of commission reaction time.

As can be seen from table 7.3.5 although there was a tendency for the anorexic group to be less impulsive on 'Hungry Kevin' and to have shorter latencies to respond on free choice trials than the control group these differences were not statistically significant ($p>0.05$).

After completion of 'Hungry Kevin' participants were asked about the choices they had made and reasons for making those choices. Reasons given for choosing the white button (smaller immediate reinforcer) by all groups were either because there was less delay to reinforcement or they did not have to wait. Control participants who chose the blue button (larger later reinforcer) said it was because they got to play the game longer before it was interrupted. This was also the reason given by 2 of patients, however the majority of the patients who chose the larger later reinforcer (blue button) claimed that there was no reason for their choice. One participant said it was because her kitchen was blue and another said she chose the blue button as she felt the game would be over quicker by making this choice. When asked why she thought this, the patient did not have any reason.

As two of the inpatients were on medication, one was taking an anti-psychotic drug (Chlorpromazine) and the other was taking an anxiolytic drug (metazapam) the data were reanalysed with the two medicated inpatients omitted. The differences that were found with the two medicated patients in the analysis all remained significant and no other significant group differences between the anorexic inpatients and the controls were revealed.

Correlational analysis.

Correlations were computed for each of the two groups, anorexic inpatients and controls, separately. Correlations seen with the controls were: CPT errors of commission correlated significantly and negatively with CPT hit reaction time (rho = -0.53, n=16, p=0.037), and CPT hit reaction time correlated negatively with errors of commission reaction time (rho = -0.83, n=16, p=0.042). Those who responded faster to targets on the CPT also made more errors of commission, and responded slowly to non-target stimuli. Bets-16 correlated positively with I-7 venturesomeness (rho = 0.53, n = 16, p=0.036) and negatively with CPT errors of commission reaction time (tho = -0.84, n =16, p=0.036). There were no significant correlations with any of the measures and either 'Hungry Kevin' (percentage of impulsive choices) or 'Hungry Kevin' latency to respond on free choice trails.

There were only two significant correlations between measures with the anorexic inpatient data. Bets-16 correlated with CPT errors of omission (rho = 0.54, n =15, p = 0.038) and venturesomeness correlated with CPT errors of commission reaction time (rho = 0.61, n=15, p= 0.046). Those low on thrill risk taking behaviour were also slower to respond to non-target stimuli. All correlations were two-tailed.

7.3.3 Discussion.

At the outset of the study it had been intended to see all new inpatients who agreed to take part within two weeks of their admission to the unit. This however was not possible due to constraints within the unit including failures to be notified of new inpatient admissions and holidays of the staff liasing with the investigator. Therefore the time at which the inpatients were seen after admission varied from one week to six weeks. Although the inpatient anorexics were at various stages of illness and treatment, none were recovered. The difference between those seen at admission and those who had been inpatients for longer was the length of time they had been receiving treatment. Inpatient treatment consisted of re-feeding, and multi-discipline therapy involving nursing staff, occupational therapists, dieticians, psychologists and psychiatrists. The number of bulimic and anorexic outpatients recruited was too low to enable the groups to be included in statistical analysis. Therefore the comparisons were between current anorexic inpatients and female controls. The female controls had been screened for abnormal eating attitudes and bulimic behaviours, and only those with low scores were included as controls. Although body mass index (BMI) scores were available for the controls (not reported) they were not available for the anorexic nervosa inpatients, as they were not reported on the patients notes. As the ICD-10 diagnostic criteria for anorexia nervosa requires that “Body weight is maintained at least 15% below that expected...or body mass index is 17.5 or less” (WHO, 1992; p 177) then it is likely that the anorexic inpatients all had low BMI scores which are typically seen with anorexia nervosa.

There were no significant differences in age between the anorexic inpatients and the controls. Although the controls and anorexic inpatients were not matched for premorbid IQ and/or years of education, Seed, Dixon, McCluskey & Young (2000) reported similar IQ scores, which were not significantly different, between an anorexic group and a control group.

Although two of the anorexic inpatients were taking medication, when they were excluded from the data analysis this had no effect on the statistical results. So all between group differences discussed include the two medicated anorexic inpatients. It had been planned to recruit 20 from each group (anorexics and bulimics) to enable adequate statistical power. The Eating Disorder Unit reported that they had seen very few referrals for women with bulimia nervosa during the recruitment period and this was not the usual trend. The number of referrals who declined to take part in the study was never revealed.

Beck Depression scores were missing for four of the anorexic inpatients due to the investigator being unable to obtain these scores from the Eating Disorder Unit when the psychologist left to take up a post elsewhere. It would be probable that the 4 participants who had missing BDI scores would also have high depression scores as depression is very common among those suffering with anorexia nervosa (Bulik, 2002).The eleven anorexic inpatients for whom there were depression scores had significantly higher self-reported levels of depression than the female controls. Jimerson et al., (1990) noted that co-morbid depression seen in eating disorders often preceded the eating disorder, thus suggesting that depression is not simply a consequence of disorder. Bulik (2002) reports that both patterns of onset occur, that is depression before the development of anorexia nervosa and vice versa, and that re-feeding may improve depression however long term studies suggest it persists beyond recovery. However in the present study it is not known whether the high levels of depression reported by the anorexics is a consequence of the eating disorder or preceded it. Longitudinal studies or retrospective accounts would be required to address this issue.

The female control group scored significantly higher than the anorexic inpatients on both the I-7 scales of venturesomeness and impulsiveness as predicted. Fahy & Eisler (1993) reported that women with bulimia nervosa scored significantly higher on both impulsiveness and venturesomeness than anorexics, but the bulimics did not differ from controls. They do not report whether the anorexics differed from controls on impulsiveness and venturesomeness. As venturesomeness is measuring the sensation seeking aspect of impulsivity where the individual is aware of the risk involved but engages in the behaviour for the thrill, it was expected that the anorexics should score lower than the controls on these measures. The impulsiveness scale deals with what Eysenck & Eysenck (1991) consider to be the pathological risk taking behaviour where an individual does not look ahead to the consequences of behaviour and engages in the behaviour regardless.

Inpatients with anorexia nervosa demonstrated a fast and inaccurate style of responding on the CPT, by responding more often and more quickly to non-target stimuli (errors of commission) than controls. Errors of commission are considered to be a measure of impulsivity, however as Halperin et al (1991) note certain types of errors of commission, on the AX version of the CPT, may actually reflect inattention, as it may be a failure to attend to the stimulus which preceded the X stimulus. It may be that the anorexics made more errors of commission due to responding to the letter X without having attended to the preceding letter. This could be one explanation as to why the anorexic group made more errors of commission, however if it was a case of inattention then it would be expected for the anorexics to also make more errors of omission. Whilst there was a tendency for the anorexic group to make more errors of omission in comparison to the controls, the difference was not significant. The results are in line with those of Seed et al (2000) who reported that females with anorexia nervosa made significantly more errors of commission and errors of omission compared with a control group. Without information on the types of commission errors made, suggestions that the results may represent inattention in the anorexic inpatients is purely speculative. The greater number of commission errors by the anorexic inpatients may be a consequence of their faster reaction times, which is in line with impulsive behaviour that is indicated by fast and inaccurate responses in tests such as the MFFT (Kagan et al 1964).

It was hypothesised for the anorexic inpatients to be more self-controlled on 'Hungry Kevin' and choose the larger later reinforcer more than the controls. Although there was a tendency for this to be the case there was however no difference between the groups. Furthermore the mean score for the anorexic inpatients approached 50% which suggests indifference and is indicative neither of self-controlled or impulsive behaviour. It may be that this is not an aspect of self-control which is evident in anorexics and their self-control may be specific to food intake. The paradigm might yield different results if the reinforcer was more food related. However in 'Hungry Kevin' the task is to get 'Hungry Kevin' to eat the numbered balls, and this involves some weak association with eating behavior. It may be that the anorexics enjoyed the sensation of a computer character eating as it is a behaviour that they resist.

An alternative explanation for the anorexic inpatients not demonstrating self-controlled behaviour on 'Hungry Kevin' is that they may find waiting for reinforcement aversive and there is support for this notion in the comments made by participants as to the reasons they made the choices that they did. Participants who chose the smaller immediate reinforcer gave the reason of not liking the delay to reinforcement or not liking the wait. It may be that anorexics are self-controlled where food intake is concerned but they may be prone to impulsive behaviour, in some domains unrelated to eating, like those with bulimia nervosa. Where food is concerned the anorexics, unlike the bulimics, keep control over the urge to eat and restrict their food intake whereas bulimics experience a frequent failure of control and then binge. This issue is something that could be investigated in future research as there are reports that restricting anorexics are younger than bulimics (Garner et al.,1993) and this was found in the present research despite the low number of bulimic patients recruited. Furthermore it has been reported that restricting anorexics seem to move to the binge purging type of anorexia and then to bulimia when the hypercontrol that characterises anorexia nervosa eventually breaks down. Garner et al (1993) suggested that there is a small proportion of patients with eating disorders who can control their urges for food for protracted periods of time without any loss of control. However the control of restricting anorexics has a tendency to break down over time, and furthermore many of the restricters eventually engage in purging behaviour.

The reduced impulsiveness and venturesomeness of anorexia inpatients are in opposition to the results on the continuous performance test where they were impulsive, by their fast and inaccurate responding. This may be due to self-report measures, by their nature, informing us how the participant views themselves whereas objective measures reflect how they behave. Indeed it might be that this postulated lack of insight contributes to the poor prognosis in anorexia nervosa.

The results of the correlational analysis were in line with those reported previously, that is there were low significant or non-significant intercorrelations between various measures of impulsivity (Gerbing et al, 1987). Most of the significant correlations seen with the control group data were with CPT measures correlating with other CPT measures. CPT errors of commission correlated negatively with hit reaction times, therefore those who responded to more non-targets were faster to respond to targets. Participants who scored high on the I-7 venturesomeness also scored high on the Bets-16, and this has previously been found in this thesis (see experiment 8.1). These results are what would be expected if both are measuring risk taking behaviour where the individual is aware of the consequences of behaviour. The two correlations in the anorexic group were again not between the different measures of impulsivity but rather Bets-16 correlated with CPT errors of omission, so those who demonstrated more risk taking behaviour were also more inattentive. The other correlation was between venturesomeness and errors of commission reaction time, those who were more risk taking were also slower to respond to non-targets. The lack of correlations with percentage of impulsive responding on 'Hungry Kevin' is in keeping with the general theme of results reported elsewhere in this thesis. It may be that delay of gratification or discounting of delayed rewards is a separate dimension to impulsivity, certainly that captured by the self-report questionnaires.

The final experimental chapter investigates impulsivity and risk-taking in recreational drug users.

Chapter Eight

Impulsive and risk taking behaviour associated with illicit drug use.

8.0 Introduction

The evidence presented in chapter two indicates that individuals who have problems with impulse control have often been found to have problems with drug or alcohol use and vice versa (Allen et al., 1980; King et al., 1990). However is it impulsivity which leads to substance use (and in some cases abuse), or substance use which leads to impulsivity? Some researchers have suggested that impulsivity is not a predictive factor (Hesselbrock, 1986). Whilst impulsivity is a symptom of drug abuse, are individuals who are recreational drug users but not abusers also more impulsive?

The studies in this chapter include a number of studies with some overlap of content and a consequent meta-analysis to investigate impulsivity and risk taking behaviour in relation to the recreational use of illicit substances, especially the substance commonly known as 'ecstasy'. As outlined in chapter two, studies have found that substance abusers score higher on measures of impulsivity (Allen et al, 1998; King et al., 1990; McGown, 1988). In addition to substance abusers having higher levels of impulsivity recreational drug users who also used the substance 'ecstasy' have been reported to have increased self-reported impulsivity (Morgan, 1998; Parrott, Sisk & Turner, 2000).

Research into the usage of drugs in Britain has reported that 1 in 7 of the general population has used cannabis (Baker & Marsden, 1995). A survey of 3075 second year university students from ten UK universities found 60% of men and 55% of women reported having used cannabis once, whilst 34% had taken two or more illicit substances and 19% had used four or more (Webb, Ashton, Kelly & Kamali, 1996). Research found that certain drugs are mutually used, in that when one of either LSD, amphetamines or ecstasy (MDMA) were taken, then the individual is likely to have taken one or both of the others. Webb et al (1996) reported that LSD, amphetamines, ecstasy and amyl nitrate had each been used by 13-18% of the student population. Morgan (1999) found that ecstasy users tended to use other illicit substances such as amphetamine, cocaine, cannabis and LSD.

To extend the study of impulsivity, drug use and impulsivity were investigated in a non clinical non-drug abuse population, this was undergraduate students. This population was chosen as the age group of undergraduate students is representative of the age group in the general population who use the most illicit drugs recreationally. The peak period for drug use being from 16-35 years of age (Baker & Marsden, 1995). Interest was specifically in the illicit substance 'ecstasy' or 3,4-methylenedioxymethamphetamine (MDMA) as this has been found to be neurotoxic in animal studies (for a review see Steele et al, 1994) and leads to depleted levels of the neurotransmitter serotonin (5-

Hydroxytryptamine, 5-HT), with increasing evidence to suggest that it may also be neurotoxic in humans (Steele, et al., 1994; McCann et al 1998).

MDMA is considered to exert its effect predominately on the neurotransmitter serotonin (Steele et al., 1987) although dopamine releasing effects have also been reported (Nash, 1990). In animals, treatment with the drug ecstasy (MDMA) leads to long term decreases in brain 5-HT and 5-HIAA levels (Schmidt, 1987). These neurotoxic effects of MDMA have been seen in a variety of species including rats, monkeys and baboons (McCann, Lowe & Ricuarte, 1997). 5-HIAA is a major metabolite of 5-HT and can be measured in cerebrospinal fluid (CSF), and has been taken as a marker of central serotonin levels. Studies with humans have reported lower levels of CSF 5-HIAA in ecstasy users compared to non ecstasy users (Ricuarte et al, 1990; McCann et al, 1994) with Ricuarte et al (1990) reporting a 26% reduction in 5-HIAA levels in MDMA users compared with controls. A blunted prolactin response and cortisol response were seen to d-fenfluramine stimulation in MDMA users, who had used the substance at least 25 times, compared with controls and there was a trend toward a significant negative correlation between prolactin and TPQ novelty seeking scores (Gerra; Zaimovic; Giucastro; Maestri; Monica; Sartori; Caccavari & Delsignore; 1998). Furthermore evidence from animal studies suggests that low 5-HT levels are associated with increased impulsivity (Fletcher, 1993). Low levels of serotonergic functioning have also been reported in individuals who have engaged in behaviours that can be considered to be impulsive in nature such as parasuicide (Lidberg, Truck, Åsberg, Scalia-Tombal & Bertilsson. 1985). Previous research has also reported increased impulsivity in ecstasy users (Morgan, 1998).

These reports indicate that recreational drug use is relatively common, and drug abuse and, recreational ecstasy use, have been associated with increased impulsivity. Animals treated with 'ecstasy' (MDMA) exhibit reduced 5-HT levels and low 5-HT levels in both animals and humans have been associated with impulsive behaviour. Consequently these lines of evidence, that illicit drug use is associated with impulsivity and that ecstasy use is proposed to be a 5-HT neurotoxin and low levels of 5-HT are associated with impulsivity, leads to the hypothesis that ecstasy use in humans is associated with increased impulsivity.

The aim of the experiments in this chapter were to investigate group differences between ecstasy drug users, non ecstasy drug users and non-drug users on self-report measures of impulsivity and a behavioural measure of risk taking behaviour. Based on the literature reviewed it would be expected for higher drug use to be associated with more risk-taking and impulsive behaviour, especially in those who use ecstasy. The studies were limited to pencil and paper measures because the nature of the studies involved the recruitment of large numbers of participants to obtain adequate sample of ecstasy users. Furthermore data collection of a sensitive topic conducted in groups rather than on a one to one basis was considered to allow for greater anonymity. Therefore the use of the computer tasks was impractical.

8.1. Experiment 1. Self-reported impulsivity and risk-taking in drug use.

Introduction.

The illicit substance 3,4-methylenedioxymethamphetamine (MDMA), commonly known as 'ecstasy', is a popular recreational drug in most European countries, including the United Kingdom. In the UK ecstasy use is usually associated with the 'rave scene'. MDMA was patented in 1914 as an appetite suppressant and was banned for clinical use in the USA in 1985 due to its neurotoxicity and potential for misuse (Henry, Jeffreys & Dawling, 1992). Whilst in the UK MDMA has been listed as a class A drug since 1977 under the Misuse of Drugs Act, 1971.

Earlier studies have indicated that 13% of university undergraduates in the UK had taken ecstasy at least once, with 2.7% reporting regular use (Webb, et al. 1996). General population data reports 2% of people in the UK having used ecstasy (6% of 16-29 year olds); and 1.6% in Germany (Griffiths et al, 1999 summarised in Shifano, 2000).

Parrott, Sisk & Turner (2000) used the I-7 to investigate impulsivity in ecstasy users and distinguished between light ecstasy users and heavy users. Light users were defined as those who had taken ecstasy on less than or equal to 20 occasions (range 1-20) and heavy users were those who had taken ecstasy on more than 20 occasions. There was a third group of non ecstasy users, however the non users had used other drugs. There were no differences in scores on the venturesomeness scale between the three groups. On the impulsiveness scale the non ecstasy users scored lower than both the light and heavy ecstasy users, however only the difference between non and heavy ecstasy users was significant. Parrott et al (2000) also found that compared to non users the heavy ecstasy users reported more obsessionality, anxiety and poor appetite. These behaviours have also been linked to lowered serotonin levels. Although the non users were non users of ecstasy they had used other substances and group differences may have been due to the differences in the usage of those other substances. As has been noted ecstasy users tend to use other substances (Morgan, 1999; Hammersley, Ditton, Smith & Short, 1999; Schifano, 2000) and without a proper non-drug using control group it is difficult to conclude whether the results are due to ecstasy use or due to the use of other substances.

Studies that have looked at the link between impulsivity and substance abuse have used polydrug users, but most of these have not looked at individuals who have and have not used ecstasy (MDMA) separately (Parrott & Lasky, 1998; Parrott et al, 1998). This may account for the higher levels of impulsivity in drug users reported in some studies and not in others. It may be the case that only certain types of drug use are associated with increased levels of impulsiveness. As both impulsivity and MDMA use have been linked with reduced serotonin function in animals and humans then it makes sense to look at those who have and have not used MDMA independently. This however is difficult, as many people who have used ecstasy recreationally have also used other illicit substances. A study in Scotland investigating patterns of ecstasy use in 209 people who had used ecstasy at least once revealed that all had also used other illicit substances, especially stimulants and hallucinogens. Moreover heavy ecstasy users had taken cocaine and amphetamines more often than light and medium ecstasy users and non ecstasy users; and the search for people who were ecstasy only users failed to yield a single participant (Hammersley, Ditton, Smith & Short, 1999).

Morgan (1998) overcame this problem by dividing participants into a non-drug use control group and two groups of recreational drug users. The two groups of recreational drug users were both polydrug users, but there was an MDMA group, those who had used ecstasy, and a polydrug group who had not used ecstasy. Drug use reported included alcohol and cigarettes plus illicit substances. Both the MDMA polydrug use group and the polydrug use (no MDMA) group scored significantly higher on the venturesomeness scale of the I-7 than the non-drug group; there was however no difference between the ecstasy group and the polydrug group (Morgan,1998).The MDMA group also scored higher on the impulsiveness scale than the non-drug use group and there was a linear relationship between impulsiveness scores and amount of ecstasy taken.

The present study was designed to investigate impulsivity in recreational drug users using the I-7 and the Bets-16 paradigm. As the Bets-16 is a measure of risk taking behaviour it is anticipated that recreational drug users will have higher scores. As the I-7 is a self-report measure and the Bets-16 is an objective measure of risk-taking, based on previous reports correlation coefficients between the two measures would be anticipated to be low. From previous findings (Morgan, 1998) drug users would be expected to have higher impulsiveness scores than non-drug users.

8.1.1 Method

Participants

One hundred and ninety seven psychology undergraduates took part in the study as part of a research methods practical. Participants were 156 females aged 18-47 (mean 22.8 ± 6.5) and 41 males aged 18-42 (mean 21.9 ± 5.8). There were no differences in age between males and females ($t(195) = 0.86$, $p = 0.39$).

Materials

The Bets-16. Refer to chapter 4.

The drug use questionnaire (unpublished, 1997). (See appendix XI). This is an eight item self-report questionnaire that asks individuals about illicit drug use and was designed for the purpose of this study. The questions asked were based on the types of information collected by other researchers (e.g. Parrot, 1998). Question 3 asks participants to indicate whether they have used illicit drugs or not and if so to indicate which ones. Four of the questions pertain specifically to ecstasy use and ask information such as: the number of times ecstasy has been taken (participants indicate according to categories <10, 11-20, >20 times), how much is typically taken at any one time, the most ecstasy taken at any one time and the last time ecstasy was used. From the information on the drug use questionnaire 4 categories of drug use were derived. These were (1) No illicit drug use, (2) Cannabis only, (3) Polydrug use but no ecstasy, (4) Polydrug use and ecstasy use.

I-7 Questionnaire (Eysenck, Pearson, Easting and Allsop, 1985). Scores on three scales are obtained, impulsiveness, venturesomeness and empathy. Higher scores reflect higher levels of the trait. Refer to chapter 3 for further details.

Procedure

Participants were approached in a research methods practical class and asked to participate in the study. There were approximately 12 participants in each practical and recruitment was conducted over two weeks. Participants were given an information sheet and informed that all information given was confidential and would be not disclosed to anyone else connected to the university or to any other third party. They were informed that if they declined to take part this would have no bearing on their performance in the unit, research methods. Those who were willing to take part were instructed to sign the consent form after reading the information sheet. They were further instructed to work steadily and not to discuss any of the questions with their neighbour. Participants completed the three measures in the order of their choice. This took approximately

15-20 minutes. Consent forms were collected up prior to collection of the data and participants were debriefed after data collection. Part of the data from those who participated was used for their research practical.

8.1.2 Results.

Based on the information given on the drug use questionnaire individuals were assigned to one of four groups. These were (1) Never used drugs (2) Used cannabis only (3) Polydrug users without ecstasy and (4) Ecstasy Users. Details of alcohol and tobacco use were not requested therefore the drug category was specific to illicit drug use.

Of the 197 participants 45.2% (89) reported never having used any illicit substances, 21.8% (43) reported having used cannabis only, 13.7% (27) having used various other illicit substances excluding ecstasy and 19.3% (38) having used ecstasy on at least one occasion. All except one (2.6%) of the ecstasy users had also used other illicit substances. Overall 53.3% (105) had used cannabis. Frequencies of females and males by category of drug use are shown in table 8.1.1.

Table 8.1.1. Percentages (and n), of females and males in each of the drug use groups.

	Drug Use Category				
	Non users	Cannabis	Polydrug	Ecstasy	Total
Sex					
Females	83.1 (74)	83.7 (36)	63.0 (17)	76.3 (29)	79.2 (156)
Males	16.9 (15)	16.3 (7)	37.0 (10)	23.7 (9)	21.8 (41)
Total	100 (89)	100 (43)	100 (27)	100 (38)	100 (197)

As can be seen from the frequencies in table 8.1.1 females made up 79.2% of participants and males 21.8%. Nearly half of the females, 47.4%, were non-drug users in comparison with 36.6 % of males. Of the remaining females 23.1% were cannabis users, 10.9% polydrug users and 18.6% ecstasy users. The distribution of the males across groups were 17% cannabis users, 14.4 polydrug users and 22% ecstasy users. The distribution of males and females within each drug use category was not significantly different (χ^2 (3) = 5.89; p> 0.05).

The mean age was not significantly different between the four categories of drug use (F (3,193) = 1.20, p =0.31).

The prevalence of the use of illicit substances for the polydrug users and the ecstasy users are presented in table 8.1.2.

Table 8.1.2. Percentages and number of participants using illicit substances in the polydrug group and the ecstasy group.

	Polydrug (n = 27)		Ecstasy (n= 38)	
Drug	N	%	N	%
Cannabis	25	92.6	37	97.4
Amphetamine	10	37.0	31	81.6***
Cocaine	12	44.4	30	78.9**
LSD	6	22.2	20	52.6*
Magic mushrooms	4	14.8	13	34.2
Heroin	2	7.4	5	13.2
Amyl nitrate	0	0	4	10.5
Other drugs	3	11.1	5	13.2

*** p<0.001 ** p<0.01 * p<0.05

The other drugs reported in table 8.1.2 as having been used by the polydrug use group were steroids by one person, morphine by a second and solvents by the third person. It was not indicated whether the steroids or the morphine were for medical purposes or not. The other drugs reported by the ecstasy users were temazepam by one, ketamine by one, a third person reported use of both temazepam and ketamine, one person reported using opium and the fifth person reported use of valium. Again whether the use of temazepam and valium had been prescribed for medical purposes is unknown.

As can be seen in table 8.1.2 a large percentage of both groups had used cannabis and the use of cannabis was not significantly different between groups (Fishers exact test, n =65, p=0.57). Significantly more ecstasy users than polydrug users had used the substances amphetamine (χ^2 (1) =13.45, $p < 0.001$), cocaine (χ^2 (1) = 8.22, $p < 0.01$) and LSD (χ^2 (1) = 6.08, $p < 0.05$).

Descriptive statistics for Bets-16 and the I-7 for the three groups of drug users and the non-drug using controls are presented in table 8.1.3. Bets-16 data were missing for one participant from the non-drug use group and for one participant from the cannabis use group.

As can be seen from table 8.1.3 the mean score on the impulsiveness scale of the I-7 increased according to drug use category, with the group who had never used illicit drugs having the lowest mean score and the ecstasy group having the highest mean score. This difference between groups on the impulsiveness scale was significant (F (3,193) = 3.8; $p < 0.01$). Post hoc analysis with Tukey's test showed a significant difference between the ecstasy users and the non-drugs users ($t = 2.7$; $p< 0.01$).

Table 8.1.3. Means (± standard deviations) for the three I-7 scales and number of risky bets chosen on Bets-16.

	Drug Use Group			
	No Drug	Cannabis	Polydrug	Ecstasy
Impulsiveness	7.5	8.6	9.6	10.2^{a**}
	(4.3)	(3.9)	(4.8)	(5.1)
Venturesomeness	8.3	9.1	10.5^{a*}	11.4^{a,b*}
	(3.8)	(3.8)	(3.5)	(2.6)
Empathy	13.4	14.1	13.0	13.4
	(3.7)	(3.2)	(3.8)	(3.1)
N	89	43	27	38
Bets-16	3.7	5.0	5.5	6.0^{a*}
	(4.6)	(4.7)	(5.4)	(4.5)
N	88	42	27	38

a vs nondrug users, b vs cannabis users. ** p<0.01, * p<0.0125.

As can be seen from table 8.1.3 venturesomeness scores followed a similar trend to that seen with impulsiveness scores. Venturesomeness scores increased with drug use category, with the three drug using groups having higher mean scores than the non-drug users. Again it was the ecstasy users who had the highest venturesomeness scores. These differences between groups on venturesomeness were significant with a Kruskal-Wallis test (χ^2 (3) = 21.7; p < 0.001). Pairwise comparisons using Mann-Whitney U with Bonferroni correction applied (p< 0.0125) showed significant differences between the non-drug users and ecstasy users (U=873.0, n =127, p=0.001), non-drug users and polydrug users

(U= 795.5, n= 116, p= 0.008), and ecstasy users and cannabis users (U=517.9, n= 81, p=0.004).

As can be seen from table 8.1.3 empathy scores were similar for all four groups, ranging from 13.0 to14.1.On the empathy scale there were no significant differences between the different drug use groups ($\chi^2(3)= 1.68$; $p > 0.05$).

The number of risky bets chosen on Bets-16 increased with drug use category from the non-drug use group to the ecstasy users. The results of a Kruskal Wallis test to analyse group differences on Bets-16 scores between categories of drug use were significant (χ^2 (3) = 9.53; $p < 0.05$). Planned comparisons were carried out using Mann-Whitney U test. Bonferroni correction was applied for multiple comparisons, in this case 4 comparisons, thus adopting a more stringent significance level of 0.0125. There were significant differences in scores on the Bets-16 between the non-drug users and the ecstasy group at this level of significance (U = 1128.0, n = 126, $p < 0.0125$). No other group comparisons between non-drug users and drug users were significant nor was the comparison between polydrug users and ecstasy users (all p>0.0125).

Spearman correlation coefficients were computed to investigate the association between the Bets-16 and the three I-7 scales in each of the drug use groups.

There were significant and low correlations between venturesomeness and Bets-16 in the non-drug use group (rho = 0.24, n = 88, p = 0.025), and in the cannabis use group (rho = 0.31, n = 42, p = 0.048). There was a significant correlation between venturesomeness and impulsiveness in the polydrug use group (R = 0.54, n =27, p = 0.004) and the ecstasy use group (R = 0.35, n = 38, p = 0.03). No other correlation coefficients were significant in any of the groups (all p>0.05).

8.1.3 Discussion.

The sample in the present study were largely female (79.2%) and this distribution of females were seen across the drug use groups, with the exception of the polydrug users where only 63% were female. The distribution of females and males within each drug use category however was not significantly different and therefore the proportion of males and females within each group was reflective of the overall sample. The overall age of the males and females were similar and there was no significant difference between age of the participants in the different drug use categories.

The present findings of 53.5% of the sample having used cannabis and 19.3% of the sample having reported using ecstasy at least once are consistent with those reported by Webb et al (1996) in an undergraduate population. In line with previous studies which have reported that ecstasy users had all used at least one other substance (Hammersley, 1999), only one of the ecstasy users in the current study had not used any other substance, and many had used multiple substances. Significantly more of the participants who had used ecstasy had also used amphetamines, cocaine and LSD in comparison with the polydrug users. The high proportion of ecstasy users also using the substances cannabis amphetamines, cocaine and LSD found in the present study supports the findings of Morgan (1999). The use of cannabis was high for both groups of drug users and a small number of participants in both groups had reported using heroin.

The Bets-16 test and both the venturesomeness and impulsiveness scales of the I-7 differentiated between ecstasy drug users and non-drug users. Individuals who had reported using ecstasy plus other illicit drugs, compared with non-drug users were more impulsive, risk-taking and reported themselves as engaging in thrill seeking behaviours. This behaviour was partly reflected in the ecstasy group having significantly higher impulsiveness scores compared with the non-drug users. Although impulsiveness scores increased according to drug use, from the lowest levels of impulsiveness reported by the non-drug users and the highest levels by the ecstasy users, the ecstasy users did not differ significantly from other groups of drugs users i.e. those who had only used cannabis and polydrug users who had not used ecstasy. These findings are consistent with Morgan (1998) who reported increased impulsiveness only in an ecstasy using group compared with a non-drug using group but a polydrug use group (no ecstasy use) were not different from either the ecstasy or the non-drug groups. These findings support Morgan's suggestion that only ecstasy users have increased impulsiveness, and it is not characteristic of all drug use.

Besides the ecstasy users having significantly higher venturesomeness scores compared with a non-drug using group, the polydrug users, who reported having never used ecstasy, also had elevated venturesomeness scores compared to non-drug users. The ecstasy users also had elevated venturesomeness scores compared to the cannabis users. These results are also consistent with Morgan (1998) who found increased venturesomeness compared to non-drug using controls in both polydrug users (no ecstasy) and ecstasy users. Morgan (1998) did not distinguish between those who had only used cannabis and polydrug users. These findings suggest that it is either the higher use of substances such as amphetamines, cocaine and LSD which distinguish the group who have used ecstasy from cannabis users, or it is the use of ecstasy itself which is associated with the greater thrill seeking and risk taking behaviour seen with higher venturesomeness scores in the ecstasy group.

Eysenck et al (1985) suggested the venturesomeness scale measures risk taking behaviour where the individual is aware of the risks but engages in the behaviour regardless, whereas the impulsiveness scale measures behaviour where the individual fails to look ahead to the consequences of their actions and seems unaware of the risks involved. Whether individuals who engage in the recreational use of illicit drugs are aware of the risks or not, is not known as this information was not requested. In society there tends to be less perceived risk associated with cannabis use than with other illicit substances. Whether risk taking behaviour is considered to be domain specific is uncertain, and therefore the risks associated with illicit drug use may occur in more than one domain. Cannabis (and amphetamines) are class B drugs and in the UK whilst it is illegal to cultivate, produce, supply or possess cannabis the penalties associated with possession of it are less than with class A drugs such as cocaine, ecstasy, heroin or LSD. There are health risks associated with all drugs, both illicit and legal, however the perceived health risks of cannabis use may be less than those associated with harder class A drugs such as ecstasy. Another risk associated with drug use is social acceptance. Many people in society find it acceptable to use cannabis where they find the use of class A drugs unacceptable.

The negative effects, or risks associated with the use of drugs are often related to longer-term use and dependence. The short-term consequence of drug use is generally a pleasant and positive experience. Positive moods such as elation, energeticness, and closeness to others have been reported by recreational MDMA drug users (Davidison & Parrott, 1997). Negative mood effects from MDMA use such as depression and lethargy develop after the mood enhancing effects, when neurochemical depletion occurs (Parrott & Lasky, 1998). Vollenweider et al (1998) reported a positive enhancement of mood and well being in those given MDMA under double blind conditions to people who reported no previous MDMA or illicit drug use. Negative effects reported were insomnia, suppressed appetite and restlessness and these effects persisted for 24 hours after ingestion. Whilst risk taking has been only one theory postulated to explain drug use, there is however some support for this theory in that the Bets-16 test, which measures financial risk taking behaviour, differentiated the non-drug group from the ecstasy use group with the ecstasy users choosing significantly more risky bets.

There was also a positive correlation between the Bets-16 and venturesomeness, which is measuring risk which an individual is aware of but engages in the behaviour regardless. This correlation was however only seen in the non-drug use and the cannabis use groups and not in the polydrug or ecstasy use groups. Previous literature has reported a poor correlation between objective and self-report measures of impulsivity, and it has been postulated that one reason may be that they are measuring different aspects of impulsivity. Both the Bets-16 and venturesomeness are measuring risk taking behaviour and this is supported by the present correlation. However the bets test is specifically measuring financial risk taking behaviour, and as Zuckerman (1993) points out the venturesomeness scale of the I-7 consists mainly of items related to physical risk taking and thrill and adventure.

As both impulsivity and repeated use of MDMA are associated with lowered levels of 5-HT in both animals and humans, this could be one possible explanation for the findings in this study. McCann, Szabo, Scheffel, Dannals & Ricaurte (1998) reported that PET scans revealed a significant reduction in global and regional 5-HT transporter binding in MDMA users compared with controls who had never used MDMA. The amount of reduction correlated positively with the amount of prior ecstasy use. In the present study it was the ecstasy users who had higher venturesomeness and impulsiveness scores and who chose more risky bets than the control group (non-drug users).

If the current results of increased impulsivity in ecstasy users is due to a reduction in brain 5-HT levels then perhaps differences would be expected to be found between the non ecstasy polydrug use group and the ecstasy polydrug group. Whilst impulsivity may lead to drug use, the use of ecstasy, may itself result in higher levels of behavioural impulsivity due to low levels of 5-HT. Whilst this is purely speculative (there being no measure of 5-HT function assessed in this study) it is in line with previous research (Morgan, 1998; Ricuarte et al, 1990; McCann et al, 1994). However MDMA is not the only drug that causes lowered serotonin levels. As Ricuarte et al., (1990) state " few recreational drugs other than MDMA are known to damage serotonin neurons, a number of them are known to influence serotonin metabolism (e.g. LSD) and thus could conceivably alter CSF 5-HIAA concentration on a long-term basis" (p704). As seen in the present study a larger percentage of the ecstasy users had also used the substances amphetamine, cocaine and LSD compared to the polydrug users. These differences between the polydrug users and the ecstasy users in the use of other substances make it impossible to claim that the higher impulsivity in the ecstasy group is solely attributable to the use of ecstasy.

8.2 Experiment II. Novelty seeking and harm avoidance in drug use.

Introduction.

The relationship between personality, impulsivity and drug use were further investigated in an undergraduate population using the TPQ (Tri-dimensional Personality Questionnaire, Cloninger, 1987a) in place of the I-7. Cloninger (1987a) proposed three personality dimensions, harm avoidance, novelty seeking and reward dependence. The three different traits or dimensions are hypothesised to be linked with different neurotransmitter substances. Novelty seeking is considered to be associated with low dopaminergic activity and to be related to brain systems involving behavioural activation. Individuals who score high on novelty seeking tend to be impulsive, extravagant, quickly bored and ready to engage in new activities. The second dimension, harm avoidance, is linked with serotonin (5-HT) activity and related to brain systems involving behavioural inhibition. Individuals who score high on harm avoidance are cautious, shy and thought to have increased 5-HT (serotonin) activity. Those who score high on reward dependence are sensitive to social cues, and likely to delay gratification if they expect reward and this dimension is associated with low noradrenergic activity (Cloninger, 1987a).

Cloninger (1987b) proposed that a certain type of alcoholism, what he terms type 2 alcoholism, has a biological basis. This is characterised by high novelty seeking, low harm avoidance and low reward dependence. Cloninger (1987b) suggested that risk taking, impulsivity, aggressiveness and distractibility are some of the attributes that are linked to behavioral activation (NS), behavioural inhibition (HA) and reward systems (RD). These behaviours have been linked with adolescent substance abuse (Jessor & Jessor, 1977; Tarter; 1988;). Cloninger (1987) reported correlations between the novelty seeking scale and impulsiveness scale of the Multidimensional Personality Questionnaire. Although Cloninger's theory is mainly related to alcoholism, there is some suggestion that the combinations of high novelty seeking, low harm avoidance and low reward dependence may not be specific to alcohol but may apply to other substances of abuse.

Wills et al. (1994) using a 67-item version of the TPQ supported this. They assessed the use of cigarettes, alcohol and marijuana in 12-15 year old adolescents in a county in New York State. They reported that the highest substance use was for those individuals with high NS, low HA and low RD. They also reported that novelty seeking, and a harm avoidance subscale titled risk orientation, correlated positively with impulsiveness, risk-taking and poor self-control.

A study by Sher, Wood, Crews & Vandiver (1995) using a 44 item version of the TPQ reported that novelty seeking was significantly positively correlated with the Diagnostic Interview Schedule (DIS, Robins et al,1981) diagnosis of alcohol and tobacco abuse and /or dependence, and with each of the substance abuse disorders.

Dughier, Shifano & Forza (2001) reported on research from The University of Padova, Italy, that ecstasy users had significantly higher TPQ novelty seeking scores than controls, nearly half of whom had previously taken drugs other than ecstasy and the remainder who had never used drugs. The ecstasy users and controls did not differ on either reward dependence or harm avoidance scores. Those who had a lower lifetime consumption of ecstasy (termed experimenters) had significantly higher harm avoidance scores than ecstasy abusers indicating that they were more cautious than higher ecstasy users. Novelty seeking scores did not differ between ecstasy experimenters and ecstasy abusers.

Gerra et al (1998) reported that ecstasy users who had used on at least 25 occasions had higher TPQ novelty seeking scores than controls, they also had higher harm avoidance scores although not significantly different from controls. McCann et al., (1994) on the other hand found that ecstasy users who had used on more than 25 occasions had less self-reported impulsivity and were more harm avoidant than controls as measured by the Multidimensional Personality Questionnaire (MPQ). There were also no group differences on the Eysenck Personality Questionnaire impulsivity subscale between groups.

The present study aimed to investigate further impulsivity and risk taking in recreational illicit drug users. In place of the I-7 as a self-report measure of impulsivity, the Tri-dimensional Personality Questionnaire was used. Whilst this is not specifically an impulsivity questionnaire it is related to systems of behavioural activation and inhibition and the novelty seeking scale contains an impulsivity subscale. It is hypothesised that polydrug users and ecstasy users will have higher novelty seeking scores, low harm avoidance and low reward dependence and show higher levels of risk taking behaviour as measured by the Bets-16 test compared with the non-drug users. It will again investigate whether there are differences in risk taking between ecstasy users and other drug using groups.

8.2.1 Method

Participants.

Fifty-four psychology undergraduates took part in the study. Of the 54 participants there were 12 males aged 19-43 (mean age 29 ± 7.4) and 42 females aged 19-45 (mean age 26 ± 7.7). Age was missing for one of the males. There were no significant differences in age between males and females (t (51) = -1.21, p =0.23). Males made up 22.2% and females 77.8% of participants.

Materials.

Tridimensional Personality Questionnaire (TPQ;Cloninger 1987). A 54-item version of the 100-item version was used (Heath et al; 1994). This is a self-report questionnaire that contains three scales, novelty seeking, harm avoidance and reward dependence. Each scale is made up of 18 items. High scores reflect higher levels of the behaviour. Refer to chapter 3 for reliability details.

The Bets-16. Refer to chapter 4.

The Drug Use Questionnaire (unpublished, 1997). Refer to experiment 8.1. Following experiment 8.1 an additional question was added to the drug use questionnaire. This was 'what were the other drugs that you used?' This was added after question 6 'When did you last use drugs other than ecstasy?' Now making it a nine item questionnaire.

Procedure.

Participants were approached in research methods sessions and asked to take part. There were approximately 6 students in each session. An information sheet was given and those who agreed to take part filled in a consent form and then completed the questionnaires in the order of their choice. Upon completion participants were debriefed as to the nature of the study. It took participants approximately 15-20 minutes to complete the three tasks.

8.2.2 Results

The data were analysed to investigate the differences in scores on four different dependent variables according to drug use category. The four dependent variables were the score on the Bets-16 test and scores on the three scales from the TPQ. The four drug use categories were created in the same way as in experiment 8.1. with the groups being (1) non-drug users, (2) cannabis only users, (3) polydrug users who had not used ecstasy and (4) ecstasy users.

The polydrug users tended to be a little older than the other three groups and older than the group average, 30.1 years compared with the group average of 26.7 years. Mean age for the non-drug users were 27.1, cannabis users 25.7 and ecstasy users 25.1. However age did not differ significantly between groups of drug users ($F(3,49) = 7.1$, $p > 0.05$).

Of the 54 participants, 35.2% (19) reported never having used any illicit substance, 33.3% (18) reported having used cannabis only,13.0% (7) having used a variety of substances but not ecstasy and 18.5% (10) reported having used ecstasy on at least one occasion. All ecstasy users had used other substances. In total 63% (34) of participants reported having used cannabis. The frequencies of males and females within each drug use category are given in table 8.2.1.

Table 8.2.1. Frequencies of sex by drug use category. Figures in parenthesis are the percentages of each sex that make up the total number of participants in each drug use category.

	Sex								
	Females			Males			Total		
Drug Use	n	%		N	%		n	%	
Non users	17	40.5	(89.5)	2	16.7	(10.5)	19	35.2	(100)
Cannabis	15	35.7	(83.3)	3	25.0	(16.7)	18	33.3	(100)
Polydrug	6	14.3	(85.7)	1	8.3	(14.3)	7	13.0	(100)
Ecstasy	4	9.5	(40.0)	6	50.0	(60.0)	10	18.5	(100)
Total	42	100	(77.8)	12	100	(22.2)	54	100	(100)

As can be seen from table 8.2.1 whilst males only make up 22.2% of the total participants they account for 60% of the ecstasy users. With 50% of male participants being ecstasy users in comparison to only 9.5% of females participants being ecstasy users. The highest percentage of females was in the non-drug using group, which accounted for 40.5% of the female participants. Counts were too low in cells to analyse the distribution of males and females within each drug use category.

The percentage of participants using each of the illicit substances, for the polydrug group and the ecstasy group are presented in table 8.2.2.

Table 8.2.2. Percentages and number of participants using illicit substances in the polydrug group and the ecstasy group.

	Polydrug (n = 7)		Ecstasy (n= 10)	
Drug	n	%	N	%
Cannabis	6	85.7	10	100
Amphetamine	5	71.4	7	70.0
Cocaine	3	42.9	8	80.0
LSD	3	42.9	6	60.0
Magic mushrooms	0	00.0	1	10.0
Other drugs	0	00.0	3	30.0

As can be seen in table 8.2.2 a higher percentage of the ecstasy group had used cannabis, cocaine, LSD and magic mushrooms. The percentage of the ecstasy group and the polydrug use group having used amphetamines were similar. No drugs others than those listed were reported as having been used by any of the polydrug use group. The other drugs reported having been used by three of the ecstasy group were amyl nitrate by one, solvents by a second and the third person reported use of both benzodiazepines and heroin. Due to inadequate numbers in cells chi-square analysis could not be carried out to investigate group differences in use of each substances reported in table 8.2.2.

Group scores on the three TPQ scales and Bets-16, number of risky bets chosen, are presented in table 8.2.3.

Table 8.2.3. Means (± standard deviations) for the TPQ scales novelty seeking (NS), harm avoidance (HA), reward dependence (RD), and for the Bets-16 number of risky bets chosen.

	Drug Use Category			
	Non Users	Cannabis	Polydrug	Ecstasy
NS	8.5 (3.0)	8.9 (3.5)	11.3 (4.5)	11.7 (3.7) [a]
HA	7.4 (4.0)	8.2 (4.7)	6.3 (5.3)	4.7 (5.5) [b]
RD	11.1 (3.6)	12.4 (3.3)	10.1 (5.8)	11.0 (3.5) [b]
Bets	2.6 (2.8)	5.3 (5.0)	4.0 (3.6)	8.5 (4.2) [c]
N	19	18	7	10

a p=0.06, b =NS, c p<0.01

Mean scores in table 8.2.3 show that scores on the TPQ scale, novelty seeking, increased according to drug use category. The mean for the group who had no drug use was lower than both the polydrug use group and the ecstasy group, with the ecstasy users having the highest novelty seeking score. This difference between groups was at the margins of significance ($F(3,50) = 2.63$, $p = 0.06$). Planned comparisons were carried out using t-tests with bonferroni correction applied, adopting a significance level of 0.0125, to investigate differences between the non-drug users and both the polydrug users and the ecstasy users, and between the ecstasy users and other drug using groups. The difference between the ecstasy users and the non-drug users was significant at the 5% level of significance but not at the more stringent level ($t(27) = -2.53$, $p = 0.017$). None of the other three comparisons were significant (all $p>0.0125$).

There were significant difference between groups of drug users on the Bets-16 test (F (3,50) = 4.93, $p < 0.01$). As can be seen from table 8.2.2. the ecstasy users chose the most risky bets with the non-drug users being risk averse. The cannabis users chose more risky bets than the polydrug users. Group comparisons were investigated using Tukey HSD with the only significant difference being between the non-drug use group and ecstasy users (T = - 5.87, $p < 0.01$). No other between group comparisons was significant ($p > 0.05$).

Pearson's correlation coefficients were computed to assess the relationship between the scales of the TPQ and the Bets-16 with each of the four groups of drug users separately. There was a positive correlation between scores on Bets-16 and TPQ novelty seeking scale for the cannabis use group only (R = 0.62, N = 18, $p < 0.01$). High scores on novelty seeking were also associated with low scores on harm avoidance. There was a significant negative correlation between scores on novelty seeking and scores on harm avoidance for the non-drug use group (R = -0.57, N = 19, p=0.012) and for the ecstasy use group (R= -0.73, n =10, p = 0.017). No other correlation coefficients were significant at the $p < 0.05$ level.

8.2.3 Discussion

As in the previous experiment, the majority of participants (77.8%) in this study were female. The percentage of females within each category of drug users was not consistent with the overall percentage of females within the sample, as only 40% of the ecstasy users were female and almost 90% of non-drug users were female. The percentages of cannabis users (83.3%) and polydrug users (85.7) who were female were higher than the percentage of females overall but more representative. Ages of the female and male participants were not significantly different so different distribution of males and females within each drug use cannot be attributed to age effects.

In total 63% (34) of participants reported having used cannabis and 18.5% (10) reported having used ecstasy on at least one occasion. All of the ecstasy users had used other substances. The percentage of participants who reported having used ecstasy at least once was similar to the rate reported in experiment 8.1, and the percentage of people who had used cannabis were higher in this study.

The results of the study indicate that individuals who were ecstasy users were more risk taking and tended to be more novelty seeking than individuals who had never used drugs. The positive correlation between the number of risky bets made and novelty seeking behaviour indicates that individuals who made more risky bets, on Bets-16, also displayed more novelty seeking behaviour, this correlation was however only seen with the cannabis use group.

The correlations between the TPQ novelty seeking scores and harm avoidance scores seen with the non-drug use group and the ecstasy use group is in line with Cloninger's hypothesis. However Cloninger claims that harm avoidance and novelty seeking are weakly negatively correlated. In this study a strong negative correlation was found between the two scales for both groups. High novelty seeking scores indicate that the individual seeks novel activities and situations, whilst low harm avoidance scores indicate that the individual does not avoid aversive situations or punishment.

All three drug using groups chose more risky bets than the non-drug users with the ecstasy users making twice as many risky bets compared with the polydrug use (not significant) and over three times as many as the non-drug users. In this study the cannabis users were more risk taking on the Bets-16 than the polydrug users, although not significantly. Overall the results follow the same pattern as in experiment 8.1 indicating that ecstasy drug users are more risk taking than non-drug users. While impulsivity and risk taking is associated with drug abuse and dependence as diagnosed by DSM-IV it is not know whether impulsivity leads to individuals engaging in risky behaviour, such as drug use, or whether drug use leads to impulsivity.

Individuals who take illicit substances are taking risks across many domains. They are taking risks with their health, both physical and mental, financial risks, legal risks and social risks. However the social and legal risks associated with drug use may depend upon the context in which the drug is taken. Ecstasy use is associated with the rave scene in the UK, and in such a setting where others are taking substances it may be seen as the norm and an acceptable behaviour.

The ecstasy users reported higher levels of novelty seeking behaviour compared with the non-drug users, and whilst this was significant at the 5% level it was not at the more stringent level. Again the polydrug use group did not differ significantly from the ecstasy group or the non-drug use group. Higher levels of novelty seeking behaviour in ecstasy users is in line with previous findings and is not surprising as novelty seeking includes items that assess impulsivity. Shifano (2000) reported that ecstasy abusers scored higher on novelty seeking than controls. Wills et al; (1994) also reported high novelty seeking scores for adolescents who were substance (including cigarettes, alcohol and cannabis) users. Wills et al (1994) also found that novelty seeking correlated with measures of impulsiveness, risk taking, poor self-control, sensation seeking and negative affect. Novelty seeking scores do not appear to be state dependent with ecstasy users at least, as Gerra, Zaimovic, Ferri, Zambelli, Timpano, Neri, Marzocchi, Delsignore & Brambilla (2000) found that high novelty seeking scores remained unchanged by abstinence from MDMA for 12 months. MDMA users also had significantly higher novelty seeking scores compared to controls after 3 weeks of abstinence and this difference was still present at 12 months of abstinence. However this may reflect loss of 5-HT neurones therefore supporting that these are not state dependent effects, but rather reflect irreversible 5-HT neuronal damage.

Although the ecstasy users had a tendency towards lower levels of harm avoidant behaviour there were no differences in terms of drug use category and either harm avoidant behaviour or reward dependence. These findings are in line with Dughiero et al (2001) who reported that ecstasy users had significantly higher novelty seeking scores than controls but the two groups did not differ on either reward dependence or harm avoidance. They are also consistent with Gerra et al (1998) who reported that ecstasy users had scored significantly higher on novelty seeking and had higher harm avoidant scores, although not significantly different from controls.

As males were over represented in the ecstasy group, with half of the males being ecstasy users and accounting for 60% of the ecstasy users, differences on the Bets-16 test and a tendency for higher novelty seeking may represent sex differences between groups. Whilst an analysis was not possible between the frequencies of females and males between the drug use categories it is unlikely that differences between the ecstasy users and non-drug users were due to the high proportion of males in the ecstasy use group, as there were no differences between males and females on Bets-16 in chapter 4. Although novelty seeking scores between ecstasy users and non-drug users were not significant at the more stringent significance level, Heath et al (1994) reported that their were no sex differences on novelty seeking scores, only on reward dependence and harm avoidance.

8.3 Experiment III. Risk-taking, personality measures and impulsivity in drug using groups.

Introduction.

In experiment 8.1 the I-7 questionnaire was used to investigate impulsivity and recreational illicit drug use whilst experiment 8.2 used the Tri-dimensional Personality Questionnaire to investigate the traits of novelty seeking, harm avoidance and reward dependence. Both used the Bets-16 to measure risk taking behaviour. The results from experiment 8.1 revealed that ecstasy users had higher venturesomeness scores and higher impulsiveness scores than those who had not used drugs. Thus supporting that recreational ecstasy drug users have greater levels of impulsivity on a self report measure. The ecstasy users also chose more risky bets than the non-drug use group. The venturesomeness scale also distinguished between polydrug users and non-drug users and ecstasy users and cannabis users. Thus supporting Morgan's (1998) findings that high impulsiveness is restricted to ecstasy users, whereas venturesomeness is not.

In experiment 8.2 results for the Bets-16 test replicated the results of experiment 8.1, with the ecstasy users making twice as many risky bets than the non-drug users who were relatively risk averse. Whilst the ecstasy users also made more risky bets than the polydrug use group this difference was not significant. These results suggest that it may be the use of ecstasy that is the distinguishing factor as regards drug use and impulsive behaviour. Scores on TPQ increased across groups with the ecstasy group showing the highest novelty seeking behaviour. Although the ecstasy users had significantly higher novelty seeking scores compared to the non-drugs users at the 5% level of significance, the difference was not significant at a more stringent level. The present study was carried out to investigate further impulsiveness, venturesomeness, novelty seeking and risk-taking measures in drug users, especially those who have used ecstasy.

Nagoshi et al (1992) reported positive correlations between the TPQ novelty seeking scale and both the impulsiveness and venturesomeness scale of the I-7 in male alcohol and drug users, 82% of whom were diagnosed as drug dependent/abusive. When the data were further examined, novelty seeking correlated with abuse/dependence of marijuana, barbiturates, amphetamine, and cocaine. Novelty seeking did not correlate with DIS (Diagnostic Interview Schedule: Robins et al,1981) diagnosis of cigarette, alcohol, opiods and hallucinogenic drug abuse/dependence. Novelty seeking also correlated with antisocial personality. This is not surprising as antisocial personality disorder in DSM-IV (APA, 1994) is characterised by problems with impulsivity. These results suggest that novelty seeking and impulsive behaviour are associated with drug abuse and dependence of certain substances only.

Experiment III was undertaken to investigate impulsivity with both the I-7 and the TPQ in the same participants in relation to recreational drug use. As experiment 8.1 had yielded between group differences on the venturesomeness and impulsiveness scores and in experiment 8.2 differences approached significance on the novelty seeking scale it was hypothesised that ecstasy users would score higher than non-drug users on all three measures. In experiments 8.1 and 8.2 ecstasy users were significantly more risk taking on the Bets-16 test than non-drug users, it is therefore hypothesised that ecstasy users will be more risk taking than non-drug users.

8.3.1 Method.

Participants.

Fifty-nine first year undergraduate psychology students participated in the study to obtain research participation credit. There were 13 males, aged 18-29 (mean 20.38 $\pm$ 2.8) and 46 females aged 18-41 (mean 20.6 $\pm$ 4.1). The mean age of male and female participants were comparable and were not significantly different ($t = 0.15$, $df=57$, $p=0.88$). Females made up 78% of the total participants and males 22%.

Materials.

The Bets-16. Refer to chapter 4

The I-7 (Eysenck et al, 1985). Refer to chapter 3.

TPQ 54 item version (Heath et al., 1994). Refer to chapter 3 or experiment 8.2.

The drug use questionnaire (9 items). As used in experiment 8.2

Procedure.

Participants were recruited through research methods practical classes and participants were seen in small groups of approximately eight. Recruitment was conducted over a two week period. Written informed consent was obtained. The order of answering the questionnaires was left up to the participants and they were instructed not to confer with their neighbour. Upon completion participants were debriefed and asked not discuss the study with their fellow students who had yet to participate.

8.3.2 Results.

Four drug use groups were created in the same way as in experiment 8.1, based on the information given in the drug use questionnaire, with the groups being (1) non-drug users, (2) cannabis only users, (3) polydrug users who had not used ecstasy and (4) ecstasy users.

Of the total participants 45.8% (27) reported never having used any illicit substance, 20.3% (12) reported having used only cannabis, 16.9% (10) reported use of more than one substance excluding ecstasy and 16.9% (10) reported the use of ecstasy. Overall 45.2% (32) of participants reported having used cannabis, and all of the ecstasy users had used at least one other substance in addition to ecstasy.

The ecstasy users mean age was older than for the other three groups. Mean age for the ecstasy users was 24.2 (s.d. 4.4), non-drug users 20.0 (s.d. 4.3), cannabis users 19.2 (s.d. 0.7) and polydrug users

19.8 (s.d. 0.6). Age between the drug use groups differed significantly (F (3,55) = 4.64, $p < 0.01$). Post hoc analysis with Tukey's test showed that the ecstasy users were significantly older than each of the other three groups, non-drug users (tc=4.16, p = 0.01), cannabis users (tc = 5.03, p = 0.007) and polydrug users who had not used ecstasy (tc = 4.40, p = 0.032).

The percentages of females and males within each drug use group are presented in table 8.3.1.

Table 8.3.1. Frequencies of drug users by sex. Figures in parenthesis are the percentages of each sex that make up the total number of participants in each drug use category.

	Sex					
	Females		Males		total	
Drug Use	n	%	n	%	n	%
None	23	50 .0 (85.2)	4	30.8 (14.8)	27	45.8 (100)
Cannabis	8	17.4 (66.7)	4	30.8 (33.3)	12	20.3 (100)
Poly	7	15.2 (70.0)	3	23.1 (30.0)	10	16.9 (100)
Ecstasy	8	17.4 (80.0)	2	15.4 (20.0)	10	16.9 (100)
Total	46	100 (78.0)	13	100 (22.0)	59	100 (100)

As can be seen in table 8.3.1 males made up only 22% of all participants, and the percentage of males within each group was largest in the cannabis group where 33.3% of cannabis users were males. The group with the lowest percent of males were the non-drug using group where males only made up 14.8% of participants. Counts in cells were too small to analyse the distribution of males and females by drug use category.

Frequencies of illicit substances reported being used by the polydrug users and the ecstasy group are presented in table 8.3.2.

Table 8.3.2. Frequencies of drugs used by the polydrug use group and the ecstasy use group. N = 10 in each group.

	Drug Use			
	Polydrug users		Ecstasy Users	
Drugs Used	n	%	N	%
Cannabis	10	100	10	100
Amphetamine	6	60	7	70
Cocaine	3	30	8	80*
LSD	0	0	6	60**
Magic mushrooms	1	10	0	0
Others (amyl nitrate)	1	10	1	10

* p = 0.04, ** p = 0.005.

As can be seen from table 8.3.2 all of the polydrug users and ecstasy users had used cannabis. The use of amphetamine was similar between the two groups (60% vs 70% respectively). A higher proportion of the ecstasy users had also used cocaine than the polydrug users (80% vs 30%). Statistical analysis of these possible differences employed Fishers exact probability test because 50% of the cells had expected frequencies of less than 5. There was a difference in the use of cocaine between the two groups (Fishers exact probability p=0.04, 1-tailed). A higher proportion of the ecstasy group had also used LSD than the polydrug group 60% vs 0% (Fishers exact probability p= 0.005, 1-tailed). One of the female and one of the male ecstasy users had only used cannabis in addition to ecstasy and ecstasy had only been taken on the one occasion. Only one participant within each group had used other substances not listed and this was amyl nitrate in both cases.

Mean group scores for the non-drug users, cannabis users, polydrug users and ecstasy on the I-7 scales, TPQ scales and Bets-16 are presented in table 8.3.3.

Table 8.3.3. Mean ± standard deviation scores on I-7 scales, TPQ scales and Bets-16 for each drug use group. N = 59.

	Drug Use Group			
	Non-drug	Cannabis	Polydrug	Ecstasy
n	27	12	10	10
Impulsiveness	7.4 ± 3.4	8.7 ± 3.3	10.3 ± 4.3	10.5 ± 3.6 [a]
Venturesomeness	10.0 ± 2.9	9.7 ± 3.3	11.1 ± 2.6	11.2 ± 1.8
Empathy	14.2 ± 2.9	15.0 ± 1.95	13.4 ± 2.8	14.8 ± 3.4
Novelty seeking	7.9 ± 2.6	10.1 ± 2.4	11.0 ±3.4	12.1 ± 2.6[a]
Harm avoidance	6.9 ± 4.0	8.4 ± 4.4	4.4 ± 3.2	6.9 ± 2.2
Reward depend	11.5 ± 2.7	11.3 ± 2.6	11.6 ± 2.3	11.7 ± 2.6
Bets-16	4.7 ± 5.3	4.4 ± 3.7	7.8 ± 4.3	5.0 ± 4.9

a non-drug users vs ecstasy users p <0.025.

One way analysis of variance was conducted on each of the dependent variables to assess differences between drug use groups. As seen in table 8.3.3 impulsiveness scores increased across the drug use groups with the non-drug users showing the least impulsiveness and the ecstasy users the most. Group differences on the I-7 impulsiveness scale were at the margins of significance ($F(3,55) = 2.73$, $p = 0.052$). As it was hypothesised for the ecstasy use group and the polydrug use group to score significantly higher than the non-drug use group planned comparisons were carried out using T-Tests with Bonferroni correction applied for multiple tests, in this instance 2, adopting a significance level of $p < 0.025$. The difference in impulsivity between the non-drug use group and the ecstasy group was significant ($t = -2.44$, $df = 35$, $p < 0.025$) with the ecstasy users having higher levels of impulsiveness. Impulsiveness scores did not differ significantly between the non-drug users and the polydrug users at the more stringent level of significance but did at the 5% level of significance.

Whilst the polydrug users and the ecstasy users had higher I-7 venturesomeness scores than the non-drug users and the cannabis users these differences were not statistically significant ($F(3,55) = 0.93$; $p > 0.05$). There was no obvious pattern with the I-7 empathy scores and empathy did not differ significantly according to drug use ($F(3,55) = 0.55$; $p > 0.05$).

Figure 8.3.1 shows the mean scores for each drug use group on the TPQ novelty seeking scale.

the non-drug use group however this difference was not statistically significantly from the non-drug use group ($p > 0.05$).

As can be seen in table 8.3.3 the polydrug use group reported the least harm avoidant behaviour but the ecstasy group mean was the same as the non-drug users. TPQ harm avoidance scores did not differ significantly according to drug use group ($F (3,55) = 2.15$; $p > 0.05$). TPQ reward dependence scores were approximately 11 for all groups and did not differ significantly between groups ($F (3,55) = 0.06$; $p > 0.05$).

In the Bets-16 it was the polydrug users who chose the most risky bets with a mean of 7.8 compared with a mean of 5.0 for the ecstasy users. There were however no significant differences between groups according to the number of risky bets chosen ($F (3,52) = 1.07$, $p > 0.05$).

As there were between group differences on impulsiveness and harm avoidance, correlations with those variables are reported according to drug use group. Correlations between other variables are reported for the whole sample. Pearsons correlations between all scores for each of the four groups individually found a common correlation between impulsiveness and harm avoidance in the non-drug use group ($R=0.49$, $n = 27$, $p=0.009$), the cannabis use group ($R = 0.79$, $n=12$, $p =0.002$) and the polydrug use group ($R = 0.63$, $n = 10$, $p=0.049$). Bets-16 scores correlated with impulsiveness ($R= 0.68$, $n=12$, $p = 0.016$) in the cannabis use group only, and empathy correlated negatively with impulsiveness

(R = -0.63, n = 10, p = 0.049) in the ecstasy use group. Data from all participants in the study showed a positive correlation between empathy and reward dependence (R = 0.39, n = 59 , p = 0.002).

8.3.3. Discussion.

As in the two previous experiments, the majority of participants (78%) in this study were female. The percentage of females within each category of drug users was fairly representative of the overall percentage of females with the exception of the cannabis only group where females made up just over 66% of that group. Ages of the female and male participants were not significantly different. Age between the drug use groups was significantly different with the ecstasy users being significantly older than the non-drug users, the cannabis users and the polydrug users. However age is not considered to be a contributing factor with the findings as impulsivity and risk-taking behaviour generally decreases with age (Eysenck et al., 1985).

Overall 45.2 % of the sample reported having used cannabis which is lower than that found in the previous two studies and lower than the rate reported by Webb et al. (1996). The percentage of participants reporting having used ecstasy was just under 17% and this was also lower than that found in the previous two studies (18.5 & 19.3%). All of the ecstasy users had used at least one other substance, with two having used only cannabis in addition to ecstasy and ecstasy had only been used on the one occasion. In line with the findings from the two previous studies a large proportion of both groups had used cannabis and significantly more of the ecstasy group had also used the substances cocaine and LSD compared with the polydrug use group.

The ecstasy users again had the highest self-reported impulsiveness on the I-7 impulsiveness scale and this was significantly higher than the non-drug users. The results on the venturesomeness scale from experiment 8.1 were not replicated in this instance, which was unexpected as drug use is a behaviour that involves risk and can be considered a sensation seeking behaviour. Morgan (1998) reported that both polydrug users who had not used ecstasy and ecstasy users had higher levels of venturesomeness compared with non-drug users whereas only ecstasy users had higher impulsiveness scores. Morgan however only included ecstasy users who had used on at least 20 occasions, which could account for his findings, whereas the number of times that participants had used ecstasy in this study varied from once to greater than 20. However like the current results Morgan did not find a difference between the two drug use groups on either venturesomeness or impulsiveness. The four groups did not have different levels of empathy and there was no reason to suggest that this would be otherwise.

Results on the Bets-16 were also not as expected and although there were no significant differences between groups it was the polydrug users who were more risk taking and the ecstasy users in this instance showed a similar profile to the non-drug users. The previous two studies have found that the polydrug users had a tendency to be more risk averse than the ecstasy users and that ecstasy users make significantly more risky bets compared with non-drug users. There appears to be no explanation for the findings as the sample size was similar in the present study to experiment 8.2 and both included low numbers of ecstasy users. It is unlikely that the results are attributable to the higher age of the ecstasy users as the mean score on Bets-16 test was comparable to the mean score reported in experiment 4.1 and furthermore experiment 4.4 which had included a group with a higher mean age than undergraduate students actually found that they scored higher on Bets-16 than the undergraduate students. A positive correlation between Bets-16 and impulsiveness was seen only in the cannabis use group, which indicates that those who scored high on impulsiveness also made more risky choices on the Bets-16 task. It was the cannabis use group who had the lowest mean score on the Bets-16 task.

Novelty seeking scores were in line with previous results with both the ecstasy users and the polydrug users reporting significantly more novelty seeking than the non-drug users. The ecstasy users were not significantly different on novelty seeking in comparison with the two other drug using groups, cannabis and polydrug users. The findings from this study were consistent with experiment 8.2 and the findings of Gerra et al (1998) and Dughiero et al (2001) who did not find any differences between recreational drug users and non-drug users in terms of either harm avoidant or reward dependent behaviour.

Positive correlations were seen between TPQ novelty seeking and I-7 impulsiveness in all groups except the ecstasy use group, but there were no significant correlations between novelty seeking and venturesomeness. Unlike Nagoshi et al., (1992) who reported positive correlations between TPQ novelty seeking and both impulsiveness and venturesomeness. Correlation coefficients between novelty seeking and impulsiveness were moderate, and this finding is not surprising as novelty seeking contains items that measure impulsivity.

In summary ecstasy users showed higher self-reported impulsiveness and novelty seeking than non-drug users. Polydrug users who had not used ecstasy also had higher levels of self-reported novelty seeking behaviour than non-drug users. Contrary to expectations the ecstasy users did not demonstrate more risk taking behaviour on either the Bets-16 or venturesomeness than the non-drug users. In line with the findings of previous studies groups were not different on reward dependence, harm avoidance or empathy.

8.4 Experiment IV. Ecstasy use, impulsive, risk-taking and thrill seeking behaviour.

Introduction.

In view of the discrepancies between experiment 8.3 and the results of experiment 8.1 and 8.2 on the Bets-16 and I-7 venturesomeness scores data from all participants were pooled across the three studies to further investigate group differences between categories of drug users and non-drug users. As Morgan (1998) had only included participants who had used ecstasy on at least twenty occasions, within the ecstasy drug use group participants were subdivided to form three groups according to the number of occasions on which they had used ecstasy. They were divided into low users, (those who had used ecstasy less than 10 times), medium users (between 11 and 20 times) and high ecstasy users (greater than 20 times). The groups of non-drug users, cannabis users and polydrug users were as in the previous three studies.

It is expected that the three groups of ecstasy users will be more risk taking, novelty seeking, venturesomeness and impulsive, with the scores increasing with increased ecstasy use.

Method.

Participants

Data pooled from the previous three experiments (8.1, 8.2 and 8.3) gave a total of 308 participants, 66 males aged 18-43, mean age 22.8 (± 6.3) and 242 females aged 18-47, mean age 23.0 (± 6.6). There were no significant differences in age between males and females ($t(305) = 0.15$, $p=0.88$).

Materials

As reported in each of the previous experiments.

I-7, Bets-16, TPQ and drug use questionnaire.

Procedure

As reported in the previous experiments.

8.4.2 Results.

As not all of the 308 participants had completed all of the measures the numbers within some tables are less than 308.

The ecstasy group were divided according to the number of occasions that ecstasy had been taken, giving three groups of ecstasy users, low, medium and high lifetime users. This was done on the basis of the category of lifetime use of ecstasy indicated by participants on the drug use questionnaire where the options were less than 10, 11-20 occasions and greater than 20 occasions. This gave 31 in the low ecstasy group who had used less than 10 occasions, 5 in the medium group who had used between 11 and 20 occasions, and 20 in the high group who had used greater than 20 occasions. Overall this resulted in six groups of participants according to drug use category: no drug use, cannabis use only, polydrug users who have not used ecstasy, low ecstasy users, medium ecstasy users and high ecstasy users. There were no significant differences in age between the six categories of drug use ($F(5,301) = 1.01$, $p = 0.41$).

Frequencies of males and females within each drug use category are presented in table 8.4.1.

Table 8.4.1. Frequencies of sex by drug use. Figures in parenthesis are the percentage of each sex that make up the total number of participants in each drug use category.

	Sex					
	Males		Females		Total	
Drug category	n	%	n	%	n	%
Non users	21	31.8 (15.5)	114	47.1 (84.4)	135	43.8 (100)
Cannabis only	14	21.2 (19.2)	59	24.4 (80.8)	73	23.7 (100)
Polydrug users	14	21.2 (31.8)	30	12.4 (68.2)	44	14.3 (100)
Low Ecstasy	8	12.1 (25.8)	23	9.5 (74.2)	31	10.1 (100)
Medium E	2	3.0 (40.0)	3	1.2 (60.0)	5	1.6 (100)
High E	7	10.6 (35.0)	13	5.4 (65.0)	20	6.5 (100)
Total	66	100 (21.4)	242	100 (78.6)	308	100 (100)
Total Ecstasy	17	25.8 (30.4)	39	16.1 (69.6)	56	18.2 (100)

As can be seen in table 8.4.1 a higher percentage of males had used ecstasy (25.8%) compared with females (16.1%) and more males (21.2%) were polydrug users than females (12.4%). Whilst a higher percentage of females were non-drug users. Use of cannabis was comparable between males and females. Overall 54.9% (169) of the sample had used cannabis on at least one occasion, with 32.5% (n =100) of the sample having used two or more substances. There was no significant difference in the frequencies of females and males across drug use category (χ^2 (5) = 9.37, p = 0.10).

Information on the highest number of ecstasy tablets taken on any one occasion and the number typically taken are presented in table 8.4.2, also information on the number of weeks since ecstasy was last taken.

Table 8.4.2. The mean, minimum and maximum scores of the highest and typical amounts of ecstasy taken on one occasion and the last time taken.

	Ecstasy Use					
	Highest		Typical		Last used	
	mean	min-max	mean	min-max	Mean	min-max
Low E	1.6	0.5-4.0	1.0	0.5-1.5	142.2	1.1-416
Medium E	2.1	1.0-3.0	1.1	1.0-1.5	20.2	7.0-52
High E	3.8	1.5-8.0	1.5	0.5-2.0	28.5	0.5-208

As can be seen in table 8.4.2 the mean amount of ecstasy used on a single occasion increased with life time use of ecstasy, with the low ecstasy users typically taking 1 tablet and the most being 1.5 tablets. For the medium ecstasy users the mean highest amount taken on one occasion was 2.1 tablets with 1 typically taken. The high ecstasy users typically took a mean of 1.5 tablets with the most being taken on one occasion being a mean of 3.8 tablets. There was a significant correlation between the most ecstasy taken on any one occasion and the amount typically taken ($rho = 0.78$, $n = 56$, $p < 0.001$). With the exception of three of the high ecstasy users and one of the low use group no other participants had used ecstasy within the last two weeks. Of the three ecstasy users one had used 4 days previously, one 7 days previously and the third 10 days previously. The low ecstasy user had used 7 days previously.

The percentages of participants within the polydrug use group and the ecstasy use groups who reported having used illicit substances are presented in table 8.4.3.

Table 8.4.3. Substances used by the polydrug use group and the three groups of ecstasy (E) users, low, medium and high.

	Drug Use Group							
	Polydrug		Low E		Medium E		High E	
	n = 44		n = 31		n = 5		n = 20	
Cannabis	41	93.2%	30	96.8%	5	100.0%	20	100.0%
Amphetamine*	21	47.7%	21	67.7%	5	100.0%	18	90.0%
Cocaine**	18	40.9%	20	64.5%	5	100.0%	20	100.0%
LSD**	9	20.5%	12	38.7%	3	60.0%	16	80.0%
Mushrooms	5	11.4%	5	16.1%	2	40.0%	6	30.0%
Heroin	2	4.5%	4	12.9%	0	0.0%	2	10.0%
Amyl nitrate	1	2.3%	3	9.7%	1	20.0%	1	5.0%
Other drugs	3	6.9%	3	9.7%	1	20.0%	3	15.0%

Significant difference between groups * p<0.01, ** p<0.001

As can be seen in table 8.4.3 the percentage of participants who had used substances other than ecstasy tended to increase with increasing life time use of ecstasy. Only one participant (1.7%) had not used any other substance in addition to ecstasy and six participants (10.7%) had only used one other substance in addition to ecstasy. For five of these participants this was cannabis and the sixth participant in addition to ecstasy had used magic mushrooms. All were from the low ecstasy use group. Analysis was carried out on the frequencies of substances used between ecstasy users and non ecstasy polydrug users, using the polydrug use group, the low ecstasy users and the high ecstasy users. The medium ecstasy users were omitted from this analysis due to low counts in cells. Use of amphetamine increased with use of ecstasy with a higher percentage of the high ecstasy users using amphetamine than the low ecstasy group and the polydrug use group (χ^2 (2) = 10.9, $p < 0.01$). A similar pattern of cocaine use was seen with 100% of the high ecstasy having used cocaine compared with nearly 65% of the low ecstasy group and nearly 41% of the polydrug use group. Use of cocaine also differed significantly between the three groups (χ^2 (2) = 20.4; $p<0.001$). A higher proportion of high ecstasy users than either low ecstasy users or polydrug users had used LSD. This difference in LSD use was significant (χ^2 (2) =20.5, $p<0.001$). Again a higher percent of the high ecstasy users had used magic mushrooms than the low ecstasy users and the polydrug users. However the use of magic mushrooms did not differ significantly between groups (χ^2 (2) = 3.4; $p > 0.05$). Most of the participants in all drug using groups had used cannabis.

The other drugs used in table 8.4.3 by polydrug users were steroids by one, a second had used morphine and a third solvents. In the low ecstasy use group one had used temazepam, a second had used valium and a third participant had used solvents. One participant from the medium ecstasy use group had used opium. One of the participants from the high ecstasy group one had used benzodiazepines, a second had used ketamine and a third had used both temazepam and ketamine. It is not known whether the steroids, morphine, temazepam, valium and benzodiazapines which are obtainable on prescription were used under medical supervision or not.

Mean scores and standard deviations are presented in table 8.4.4. for the Bets-16. Data on Bets-16 were missing for 5 participants giving n =303.

Table 8.4.4. Means and standard deviations on the Bets-16 for each of the drug use groups. N = 303 .

Drug Use Group	N	Mean	Standard deviation
No Drug Use	132	3.73	4.56
Cannabis	72	4.99	4.58
Polydrug	43	5.74	4.96
Low ecstasy use	31	5.19	4.56
Medium ecstasy use	5	6.20	5.54
High ecstasy use	20	$8.20^{a,b}$	3.82
Total Ecstasy Users	56	6.36	4.54

a vs no drug use p<0.001, b vs cannabis p<0.01

As can be seen in table 8.4.4 the mean number of risky bets chosen increased with increasing drug use generally and with increased ecstasy use in particular. Normality of Bets-16 distribution was tested using one sample Kolmogorov-Smirnov. The results were significant ($p<0.05$) therefore non-parametric tests were used to analyse the data. Differences on Bets-16 scores between the six groups were significant with Kruskal Wallis test (χ^2 (5) = 22.48; $p < 0.001$). Planned comparisons were carried out with Mann-Whitney tests comparing the non-drug users with the three ecstasy using groups and the polydrug users. Bonferroni correction was applied and a significance level of $p < 0.01$ was adopted. There was a significant difference between the number of risky bets chosen by the high ecstasy users and by the non-drug users ($U = 562.00$, $N = 152$, $p < 0.001$) with the high ecstasy users choosing more risky bets. The high ecstasy users also chose more risky bets than the cannabis users ($U = 421$, $N = 73$, $p < 0.01$). No other between group differences were significant on the number of risky bets chosen (all $p >0.01$).

The pooled data from experiment 8.1 and 8.3 were analysed to investigate group differences on the three I-7 scales. Non-parametric one way analysis of variance (Kruskal Wallis test) was used as the data did not follow a normal distribution. Group means for the three I-7 scales are presented in table 8.4.5.

Table 8.4.5. Means and standard deviations for the I-7 scales. N = 254

		I-7 Scale					
		Impulsiveness		Venturesomeness		Empathy	
Drug Use	n	mean	SD	Mean	SD	mean	SD
No Drugs	116	7.51	4.11	8.68	3.70	13.62	3.53
Cannabis	55	8.65	3.79	9.18	3.69	14.29	2.99
Polydrug	37	9.76[a]	4.61	10.65[a]	3.30	13.11	3.50
Low E	23	10.48[a]	4.44	11.30[a]	2.14	14.00	2.89
Medium E	5	9.60	3.36	11.40	3.36	11.40	4.51
High E	18	11.06[a]	1.27	11.39 [a]	0.63	13.50	0.71

a vs no drug use p<0.01

As can be seen in table 8.4.5 the high ecstasy users had the highest impulsiveness score. There was a significant difference between the six groups on I-7 impulsiveness using Kruskal Wallis test ($\chi^2(5)=18.28$, $p< 0.01$). Pairwise comparisons using Mann-Whitney tests between the drug users and the non-drug users yielded significant differences between the non-drug users and low ecstasy users ($U = 825.00$, $N = 139$, $p < 0.01$), non-drug users and the high ecstasy users ($U = 628.50$, $N = 134$, $p < 0.01$) and the non-drug users and polydrug users ($U = 1544.00$, $n = 153$, $p < 0.01$).

I-7 venturesomeness scores followed the predicted trend with the three ecstasy using groups having higher mean scores. There was a significant difference between groups on the venturesomeness scale with Kruskal-

Wallis test (χ^2 (5) = 22.48, p < 0.001). Pairwise comparisons using Mann-Whitney tests with Bonferroni correction applied yielded 3 significant results. These were between non-drug users and low ecstasy users (U = 744.5, n = 139, p < 0.01), non-drug users and high ecstasy users (U = 605.0, n = 134, p < 0.01) and non-drug users and polydrug users (U = 1469, n=153, p < 0.01). There was no significant difference between the six groups on empathy scores using Kruskal-Wallis analysis (χ^2 (5) = 4.27, p>0,05).

Group means from the three TPQ scales are presented in table 8.4.6. There were no medium ecstasy users who had completed the TPQ scales. Therefore there are five group scores from the pooled data from experiment 8.2 and 8.3. Parametric one-way ANOVA were used to investigate group differences on the TPQ scales.

Table 8.4.6. Drug use group means and standard deviations for the three TPQ scales (NS, HA, RD). N = 113.

		NS		HA		RD	
Drug use	n	Mean	SD	Mean	SD	Mean	SD
No drugs	46	8.11	2.76	7.09	3.94	11.33	3.06
Cannabis	30	9.37	3.12	8.30	4.54	11.97	3.02
Polydrug	17	11.12 [a]	3.72	5.18	4.13	11.00	4.05
Low E	13	11.15[a]	2.91	5.85	4.91	11.62	2.22
High E	7	13.29 [a,b]	3.25	5.71	2.81	10.86	4.26

NS = novelty seeking, HA = harm avoidance, RD = reward dependence

a vs non-drug users, b vs cannabis users all p<0.05.

As shown in table 8.4.6 TPQ novelty seeking scores increased across the categories of drug use and with increasing ecstasy use, with the drug using groups having higher mean scores than the non-drug users. There were significant differences in novelty seeking scores between the five groups ($F (4,108) = 7.19$, $p < 0.001$). Significant pairwise comparisons with Tukey's HSD test were between the non-drug users and the polydrug users ($tc = - 3.01$, $p = 0.007$), the non-drug users and the low ecstasy users ($tc = -3.05$, $p = 0.017$), the non-drug users and the high ecstasy users ($tc = -5.18$, $p = 0.001$). The only significant pairwise comparison between groups of drug users was between the cannabis users and the high ecstasy users ($t = -3.92$, $p = 0.024$).

On TPQ harm avoidance the ecstasy users and the polydrug users reported less harm avoidance behaviour than the non-drug users however there was not a significant difference between the groups ($F (4,108) = 1.92$, $p>0.05$). The TPQ scale reward dependence scores were similar for all groups in the region of 11-12 and there were no significant group differences ($F (4,108) = 0.36$, $p>0.05$).

Spearman correlations between time since ecstasy had last been used and scores on impulsiveness, venturesomeness and Bets-16 were negative but not significant. However the correlation between time since ecstasy had last been used and novelty seeking was at the margins of significance ($rho = -0.44$, $n =20$, $p = 0.054$). Due to only having categorical data on the number of occasions that ecstasy had been taken (<10, 11-20 and >20) correlations between the measures and lifetime use of ecstasy was not possible.

As there were between group differences on Bets-16, impulsiveness, venturesomeness and novelty seeking scores Spearman correlations between the three I-7 and three TPQ scales were computed for each of the six drug use groups separately. Impulsiveness correlated with venturesomeness (rho = 0.43, n = 37, p = 0.007) in the polydrug use group only, and with novelty seeking in the non-drug users (rho = 0.50, n = 27, p = -.008) and the cannabis users (rho = 0.76, n = 12, p = 0.004). Bets-16 scores correlated with venturesomeness in the non-drug user group (rho = 0.25, n = 113, p = 0.008) and the cannabis user group (rho = 0.27, n = 54, p = 0.46). Bets-16 also correlated positively with novelty seeking (rho = 0.49, n = 30, p = 0.005) in the cannabis group only.

Other significant correlations within groups were a correlation between novelty seeking and reward dependence in the non-drug user group (rho = 0.33, n =46, p = 0.24), venturesomeness and harm avoidance in both the polydrug use group (rho = 0.67, n = 10, p = 0.35) and the low ecstasy use group (rho = -0.92, n = 5, p = 0.28). Harm avoidance also correlated with impulsiveness (rho = 0.98, n = 5, p = 0.005) in the high ecstasy use group and negatively with novelty seeking in the low ecstasy use group (rho = -0.58, n =13, p = 0.39).

As there were no between group differences on empathy, reward dependence or harm avoidance correlations were computed for all participants between these variables. Empathy correlated with reward dependence ($rho = 0.43$, $n = 59$, $p < 0.01$).

8.4.3 Discussion.

The data were combined to investigate further the findings from the previous three experiments. This also enabled the ecstasy users to be subdivided into low, medium and high lifetime use of ecstasy. The majority of participants were female and there was no significant difference in age between males and females or between groups of drug use category in terms of age.

Although males made up only 21.4% of participants they accounted for just over 30% of the ecstasy users, and 25.8% of males had used ecstasy on at least occasion compared with 16.1% of females having used ecstasy. Just under half (47%) of females reported never having used any substance. Of the whole sample, males and females, 54.9% reported having used cannabis and 18.2% reported having used ecstasy on at least one occasion. The distribution of males and females across the drug use categories was not significantly different. Therefore significant differences between groups cannot be attributed to either age differences or sex differences.

The number of ecstasy tablets typically taken on any one occasion increased with life time use of ecstasy as did the most ecstasy tablets that were reported as having been taken on any one occasion. The results show a pattern of a greater amount of the drug ecstasy being typically taken on any one occasion with greater life time usage of the drug. Only four of the fifty-six ecstasy users had used ecstasy within the last two weeks and only one had used within the last 7 days.

As the group who had used ecstasy showed greater impulsiveness and venturesomeness in experiment 8.1 and 8.3, and more novelty seeking in experiment 8.2 and 8.3 compared to non-drug users, it was proposed that ecstasy users would have higher novelty seeking, impulsiveness and venturesomeness scores. The prediction for novelty seeking was confirmed, with both groups of ecstasy users (low and high lifetime use) and the polydrug users reporting significantly higher levels of novelty seeking compared with non-drug users. Novelty seeking increased with lifetime use of ecstasy, and the group who had used ecstasy on more than twenty occasions (high users) had the highest self reported levels of novelty seeking behaviour. They also had significantly higher levels of novelty seeking than those who had only used cannabis. The correlation between time since ecstasy had last been used and novelty seeking approached significance, therefore those who had used most recently tended to demonstrate higher novelty seeking behaviour. The higher ecstasy users also displayed the lowest harm avoidance scores, which suggests that they show low avoidance of punishment, although harm avoidance behaviour was not significantly different between groups.

Drugs can induce immediate euphoric effects and aversive effects may be delayed or not occur at all with short term recreational use of drugs. A person might seek out the use of substances due to such novelty seeking tendencies and to increase arousal and these tendencies might result in non-avoidance of potentially harmful activities or situations. Consistent with the individual studies reward dependent behaviour was not different between non-drug users, cannabis users, polydrug users or ecstasy users.

Self-reported impulsiveness increased with amount and type of substance used and the polydrug users, low and high ecstasy users all reported higher levels of impulsiveness on the I-7, with the high ecstasy users being the most impulsiveness. Again the cannabis users did not differ significantly from non-drug users or drug use groups from each other. A similar pattern was seen with venturesomeness increasing with drug use, and again the polydrug users, low and high ecstasy users all had significantly higher scores compared with those who reported no use of illicit substances. Whilst the cannabis users did not display any difference in venturesomeness from the non-drug users, they had significantly less venturesomeness compared with the high ecstasy users. These findings are in line with previous reports (Morgan, 1998) and suggest that greater levels of risk taking and impulsive behaviour are associated with the use of illicit substances compared with those who do not use such substances.

In the present study the number of risky bets chosen on Bets-16 increased across drug using categories with the non-drug users choosing the smallest number of risky bets, then the cannabis users, the polydrug users and the ecstasy users making the most risky bets. Within the ecstasy using groups as the life time usage of ecstasy increased (number of occasions used) so too did Bets-16 scores and the only significant differences were between the high ecstasy using group and the non-drug users and the high ecstasy group and the cannabis users. Thus supporting the proposition that it may be the use of ecstasy that differentiates between the groups with regards to risk-taking behaviour and impulsivity. There were no significant differences in the number of risky bets chosen between the ecstasy users and the polydrug users, but again the high ecstasy users were significantly more risk taking on the Bets test compared with the controls and the cannabis users and the groups were not different in terms of self-reported empathy.

The Bets-16 data showed significant positive, but low correlations with novelty seeking and venturesomeness in the cannabis only group and with venturesomeness in the non-drug use group. Bets-16 relates specifically to financial risk taking while self-report measures assess participants across a range of domains. It might therefore be expected that correlations would be positive but low and these results are in line with previous findings of significant but low correlations between measures of different aspects of impulsivity (Gerbing et al., 1987). A positive correlation was also found with impulsiveness and both venturesomeness (in the polydrug use group) and with novelty seeking in the non-drug use group and the cannabis users. This finding is not surprising given that the novelty seeking scale contains an impulsivity subscale and Eysenck & Eysenck (1991) reported a low positive correlation between impulsiveness and venturesomeness, which was what was found in this study. Novelty seeking also correlated negatively with harm avoidance (only in the low ecstasy use group) which is in line with Wills et al (1994) who reported that substance use in adolescents was elevated when harm avoidance was low and novelty seeking was high. However it would be expected for this pattern of correlations to have been found with the polydrug use group and the high ecstasy users also. Although the sample size was low in some of the drug use groups this cannot be a factor for the lack of significant correlations, as correlations were found between other variables with low sample sizes.

These correlations suggest a person who seeks novel situations more readily avoids situations which lead to punishment less, and is more impulsive and risk-taking. However the only significant correlation in the high ecstasy group was a positive correlation between harm avoidance and impulsiveness, which does not fit the profile of correlations described above. Although it was the higher ecstasy users who were consistently more impulsive, risk taking, and thrill seeking. These findings are consistent with the profile of substance users reported by Wills et al (1994) who found that high substance users were characterised by high novelty seeking, risk taking and poor self-control.

8.5 General Discussion.

The prevalence of cannabis use amongst the undergraduate population in the present studies were higher than those reported for the general population, 54.9% vs 14.3%, by Baker & Marsden (1995). The rates from the present study were however comparable with those reported from 10 UK universities by Webb et al. (1996) where 60% of men and 55% of women reported having used cannabis once. Webb et al (1996) also reported that 34% of their undergraduate population had taken two or more illicit substances and the present rates of 32.5% having used two or more illicit substances are comparable. The present studies found that 18.2% of the student sample reported use of ecstasy on at least one occasion. This is slightly higher than the figure (13%) reported by Webb et al. (1996). Of the ecstasy sample only one of the 56 from each of the individual studies had not used any other substance and this is in line with the findings of Hammersley, et al. (1999) who reported that none of their 209 ecstasy users had only used ecstasy. The present studies also had 6 ecstasy users who had only used one other substance in addition to ecstasy. This was cannabis by five participants and magic mushrooms by the sixth person. Thus the remainder of the sample were all ecstasy and polydrug users. The difference between the polydrug use groups and the ecstasy use groups in these experiments were that the polydrug use groups had not used ecstasy on even a single occasion.

For each of the three individual studies the majority of participants were female, which is a consequence of using undergraduate psychology students. The distribution of males and females within the drug using groups in experiment 8.4, with the pooled data, revealed that whilst just under half (47.1%) of females had never used any illicit substances, this figure was just over a third for the males (31.8%). In comparison a larger proportion of males (25.8%) had used ecstasy than the females (16.1%) and were polydrug users (21.2% vs 12.4%) respectively. The percentages of males and females who had used cannabis only were similar, 21.2% and 24.4, respectively.

Ecstasy users were more risk taking on the Bets-16 test than non-drug users in both experiments 8.1 and 8.2 although not in experiment 8.3. In experiment 8.4 where the ecstasy users were divided into low, medium and high lifetime users the results were again replicated and risk taking scores on the Bets-16 tended to increase with life time prevalence of ecstasy use with those who had used ecstasy on more than 20 occasions choosing significantly more risky bets than the group of non-drug users. The Bets-16 did not distinguish groups of drug users from each other in either experiment 8.1, 8.2 or 8.3, however in 8.4 it did distinguish between cannabis users and the high ecstasy users who chose significantly more risky bets than non-drug users. With the exception of experiment 8.3, which had a low numbers of participants, the Bets-16 has distinguished between non-drug users and ecstasy users, but has not reliably distinguished between different groups of drug users. Therefore this task appears to be a useful research tool to assess risk taking behaviour in drug users, especially recreational ecstasy (MDMA users).

Self-reported impulsiveness showed consistent and robust findings across the two individual experiments and in experiment 8.4 with the pooled data: ecstasy users demonstrated more impulsiveness compared with non-drug users. In both the individual experiments and the pooled data impulsiveness scores increased according to drug use category and although impulsiveness scores did not differ significantly between groups of drug users in either experiment, ecstasy users had significantly higher scores than non-drug users. In experiment 8.4 with the pooled data the group who had used ecstasy on less than 10 occasions and the group who had used on more than 20 occasions, and the polydrug users who had not used ecstasy, all had significantly higher impulsiveness scores than the non-drug users. Self-reported impulsiveness has reliably distinguished between ecstasy using groups and non-drug users and these findings are in line with previous studies where it was reported that ecstasy users (>20 times) had significantly higher impulsiveness scores than non-drug users Morgan (1998). Parrott et al (2000) also reported that ecstasy users (>20 times) had significantly higher impulsiveness scores compared with non ecstasy drug users. However the present results did not find a significant difference between ecstasy users and non-ecstasy drug users. Morgan (1998) noted that higher levels of impulsivity on a self report measure (I-7) does not seem to be a characteristic of all drug use but seems specific to ecstasy users. The results of the two individual experiments are consistent with this theory of Morgan's where ecstasy users scored higher than non-drug users, however the pooled data (experiment 8.4) found that the polydrug (non ecstasy users) also had significantly higher scores than a non-drug using group. Allen, et al., (1998) also reported that adults with a history of drug dependence (past but not currently dependent) scored significantly higher on both the venturesomeness and the impulsiveness scales of the I-7. Thus suggesting that higher levels of impulsiveness are not state dependent and due to current drug use.

Venturesomeness also tended to increase according to drug use category with the highest scores being reported by the ecstasy users in both experiment 8.1 and 8.3. Although the scores were not significantly different in experiment 8.3 between groups of recreational drug users, the first study in the chapter (8.1) where there was a larger sample size, showed that both ecstasy users and polydrug users had higher levels of venturesomeness risk taking behaviour compared with those who had never used drugs. The ecstasy users also had significantly higher scores than those who had only used the substance cannabis. This pattern of results continued with the pooled data where both the low and high ecstasy users and the polydrug users had higher levels of self-reported venturesomeness compared with a non-drug using group. Again these results are consistent with the findings of Morgan (1998) who reported that an ecstasy using group and a polydrug (non ecstasy) group had significantly higher venturesomeness scores than a non-drug using group. Like Morgan (1998), venturesomeness in the present studies has not distinguished between groups of drug users. Although ecstasy users differ from non-drug users in terms of impulsiveness, venturesomeness and risk taking behaviour, they are not different in terms of these traits from other polydrug users who have not used ecstasy. In some cases it seems to be either the use of ecstasy per se or greater life time use of ecstasy, which is associated with increased dosing per occasion, that creates the distinction in terms of drug use and impulsive and risk taking behaviour. This impulsive and risk taking behaviour is not linked to one aspect of impulsivity either, as the I-7 questionnaire is assessing more than one aspect of impulsivity.

Wood et al (1995) suggest that variables such as thrill seeking, immediate gratification and impulsivity may help explain self-reported drug use. The measures used in the present studies reflect, amongst others, the traits of thrill seeking and impulsivity. The venturesomeness scale of the I-7 measures thrill seeking and risk taking behaviour where an individual is aware of the risks, whilst the impulsiveness scale assesses impulsive behaviour where an individual does not look ahead to consequences of such behaviour and acts largely on the spur of the moment, with the Bets-16 measuring whether an individual is financially risk averse or risk seeking.

Wills et al (1994) reported that the highest substance use was for those with high novelty seeking, low harm avoidance and low reward dependence. In experiments 8.2 and 8.3 the polydrug users and ecstasy users tended to have had high novelty seeking and low harm avoidance scores, although harm avoidance was not significantly different between the groups. The results of the two individual studies (8.2 & 8.3) both found that the ecstasy users reported higher novelty seeking behaviour compared to the non-drug group, and in the pooled data study both the low ecstasy using group and the high ecstasy using group reported significantly higher novelty seeking behaviour compared with the non-drug group. The high ecstasy group also had higher novelty seeking behaviour compared with the cannabis users. In addition to these findings novelty seeking behaviour (experiments 8.3 & 8.4) was significantly higher in the polydrug groups compared with the non-drug users. Reward dependence was similar for all groups and in the high end of the scale across the studies. These results are supported by the findings of Schifano (2000) who also reported that individuals who had previously used MDMA scored significantly higher than controls on the novelty seeking scale of the TPQ but not on either of harm avoidance or reward dependence. Cloninger (1987a) reported that those who scored high on novelty seeking and were average on reward dependence and harm avoidance were "...characterised as impulsive, exploratory,...excitable,...and disorderly" (p575). Schifano (2000) also found that those who had reported a lower lifetime consumption of MDMA ($\leq$ 25 tablets) showed significantly higher harm avoidance scores than those with higher lifetime consumption thus suggesting that they were more harm avoidant. There were no differences in harm avoidance behaviour in experiment 8.4 between a lower lifetime consumption and a higher lifetime consumption of ecstasy.

The results from the three individual studies suggest that it is the use of ecstasy which is generally associated with higher impulsive, risk-taking, and thrill seeking behaviours. This was supported in experiment 8.4 with ecstasy users divided according to life time use, where it was reliably the high ecstasy users who differed from the non-drug using group, and scores increased with increasing ecstasy use, although the high ecstasy users were not significantly different from either the low ecstasy users or the polydrug users. Therefore although the results seem to suggest that it is the use of ecstasy which is associated with these behaviours it may be the higher prevalence of use of other substances, especially amphetamines, cocaine and LSD which is the contributing factor. Furthermore it is unknown whether the higher levels of these behaviours predate the use of substances or whether it is the use of substances which lead to higher levels of impulsivity and risk taking behaviour possibly through depleted levels of brain 5-HT. The issue of what is cause and effect was also raised by McGown (1988) who reported that although multiple substance abusers scored higher on impulsivity than single substance abusers it is unclear whether impulsiveness leads an individual to take addictive agents or whether impulsiveness is a covariant of a personality that is associated with a vulnerability to addiction.

Morgan (1998) reported no correlation between I-7 impulsiveness scores and either latency or error scores on the Matching Familiar Figures (MFF 20). According to Kagan (1966) impulsive people tend to have short latencies to first response and make more errors on the MFFT. This lack of correlation between the I-7 and the MMF20 is in line with the poor correlations found on other studies between subjective (self-report) and objective measures of impulsivity (Gerbing et al; 1987). However the results from the pooled data, of the present study, yielded correlations between Bets-16 and both novelty seeking and venturesomeness. The significant correlation between TPQ novelty seeking and the number of risk bets chosen on the Bets-16 was also seen in experiment 8.2, and in experiment 8.1 there were significant correlations between Bets-16 and venturesomeness. These findings demonstrate more correspondence between objective and subjective measures of impulsivity than has previously been reported. There seems to be a relationship between the Bets-16 test, which is a financial risk taking measure, and self-report measures of risk taking and impulsivity. This supports the notion that impulsivity, at least for some, is not domain specific. A negative correlation was also seen in experiment 8.4 between novelty seeking and harm avoidance, with those who score high on novelty seeking showing low harm avoidance behaviour, although only with the low ecstasy users.

The pattern of high scores on Bets-16, impulsiveness, venturesomeness and novelty seeking seen with ecstasy users in these studies is of a person who has high levels of impulsive, thrill seeking and risk taking behaviour, and someone who seeks novel situations.

One methodological issue involved in research assessing illicit substance use is that the content and purity of tablets is not known and it has been reported that substances individuals take sold as ecstasy (MDMA) often contain other substances (King, 2000). King (1997) reported that the typical content of MDMA in tablets sold as ecstasy was close to 100mg and King (2000) reported that the MDMA content of tablets sold as ecstasy has decreased on average, from 100mg in 1994 to 80mg in 1997. More recently Christophensen (2000) reported that doses of MDMA in ecstasy tablets varied from 50-200mg with most containing 100mg, which is consistent with King's (1997) report. Furthermore King (1997) reported that mixtures of MDMA + MDEA (methylenedioxyethylamphetamine), and mixtures of MDMA + MDA (methylenedioxyamphetamine) were also seen in tablets sold as ecstasy. A record of enquiries to the National Poisons Information Service (NPIS) in London over a two year period from January 1990 to December 1991 reported that MDMA was commonly found by laboratory detection, although what was sold as 'E' (ecstasy) did usually contain MDMA, other substances such as MDA or amphetamine were identified (Henry et al, 1992). Therefore based on the above reports the effects attributed to ecstasy might not be due to ecstasy (MDMA) alone but some combination of MDMA and similar compounds.

Street seizures of drugs in the UK have found that during some periods methylenedioxyethamphetamine (MDEA) was a commoner substance than MDMA, and that other ring-substituted amphetamines as well as MDMA mixtures, and Ketamine mixed with a stimulant drug are also sold as ecstasy (King 2000). Henry et al (1992) reported that mixtures of substances in tablets sold as 'E' were uncommon and Wolff et al, (1995) reported that tablets sold as ecstasy contained primarily MDMA, although other structurally related substances such as amphetamine and methylenedioxyamphetamine (MDMEA) are also present. Coomber (1997) reports from personal communication with The Dutch Drugs Advice Bureau, who test ecstasy tablets for the presence of various substances including heroin, that "it has never, in the thousands and thousands of ecstasy and ecstasy related pills tested, found heroin to be present in them" (202). Coomber (1997) concludes that other substances found in tablets sold as ecstasy are those that attempt to mimic ecstasy, such LSD and amphetamine. In a study looking at self-reported drug use therefore the purity or the composition of the drug taken cannot be verified. However self-reports of MDMA use have been found to correlate with urine screening results (Brown et al, 1995; cited in Burgess et al 2000). Whilst analysis of drug samples provided by 16 recreational MDMA users identified MDMA in all the samples, the amount of MDMA was not reported (Ricaurte, et al, 1990). Therefore although the composition of the tablets that participants take sold as ecstasy cannot be guaranteed to contain purely MDMA, the reports above suggest that they tend to be largely made up on MDMA or similar ring substituted substances to MDMA.

A second methodological issue is that in most studies, including the three reported here, all except one of the 56 ecstasy users were also polydrug users. The percentage of high ecstasy users that had used amphetamine, cocaine and LSD was higher than for the low users and the polydrug users, differences between the groups were significant with Chi square. Therefore it is difficult to ascertain whether the increased impulsivity and risk taking behaviour is attributable to ecstasy use or the use of other substances such as LSD, cocaine and amphetamine.

McCann, Eligulashvili & Ricaurte (2000) note that the use of MDMA most often occurs in a rave situation and that the increased impulsivity seen in MDMA users (McCann et al., 1994., Morgan, 1998) may simply be a consequence of the type of person who attends raves. It could well be that those who take ecstasy are more impulsive and sensation seeking than the average person. They furthermore report that is difficult to ascertain whether the increased impulsivity is related to MDMA use or not and that prospective studies would be required to address this question. Parrott (2000) asks "...are there pre-existing differences in personality, serotonin/dopamine functioning...which can be used to identify the most susceptible individuals?" (p23). Again longitudinal prospective research would need to be done to address this question. Whilst the effects on the Bets-16 test appear to depend upon the lifetime use of ecstasy it may be that those who are more risk taking on the Bets-16 are also more risk taking with drug use, because those who were high ecstasy users also had the highest use of the substances amphetamine, cocaine and LSD.

Ricuarte et al (1990) also note that without pre-MDMA CSF 5-HIAA values, it is difficult to conclude whether a 26% reduction in CSF 5-HIAA levels of MDMA users (who were drug free for 2 weeks prior to testing) compared to controls, is a consequence of MDMA use or due to a pre-existing condition. Furthermore they note that in humans it is difficult to judge how much CSF 5-HIAA levels reflect a reduction of central nervous system 5-HT levels. However in monkeys treated with MDMA a 60% reduction in cervical CSF 5-HIAA values was associated with an 80-90% depletion of brain 5-HT and 5-HIAA and a 42% depletion of spinal cord 5-HT and 5-HIAA (Ricuarte et al., 1988).Thus suggesting that use of MDMA does deplete brain 5-HT levels, although it still leaves the question of whether findings of reduced 5-HT function in ecstasy users are cause or consequence of ecstasy use, and whether increased impulsive behaviour is cause or consequence of the ecstasy use.

Conclusion.

Despite the problems associated with self-reported drug use, purity and composition of tablets sold as ecstasy, these studies have found differences between ecstasy users and non-drug users on self-reported impulsiveness, venturesomeness, novelty seeking behaviour and risk taking behaviour. Whilst there were no significant differences between groups of drug users, with the exception of high ecstasy users and cannabis users on novelty seeking and risk taking on the Bets-16 test, it may be that it is the use of ecstasy which causes the increased impulsivity. However as Ricuarte et al (1990) note, with measuring CSF concentrations of 5-HT metabolites in ecstasy users it is difficult to know what is cause and effect, do low 5-HT levels lead to ecstasy use or is it the ecstasy use that results in the low 5-HT levels? The same situation arises with impulsivity and risk taking behaviour, do higher levels of impulsivity and risk taking behaviour result in increased drugs use, or does drug use result in increased impulsivity possibly through the mechanism of reduced brain 5-HT levels which have been linked with both impulsive behaviour and with the use of ecstasy (MDMA). Definitive answers to these questions will require prospective studies.

Chapter Nine

Conclusions

The aims of this research were to measure impulsivity and risk-taking behaviour in populations where there was reason to believe that problems with impulse control might exist. The chosen populations were selected either due to impulsivity being part of the diagnostic criteria for the disorder, or because previous research indicated that the disorders or behaviours were characterised by impulsive behaviour. The psychological literature relating to impulsivity was reviewed in chapter one and identified a number of theoretical and conceptual issues in need of resolution. These were the (i) the lack of consensus as how to define impulsivity (ii) the lack of correlations between different measures of impulsivity, (iii) whether risk taking is an aspect of impulsivity or a separate construct, (iv) that impulsivity was a multi-dimensional construct which (v) required a variety of measures to assess it (vi) and there were disorders and behaviours characterised by impulsive behaviour and were there common characteristics of impulsive behaviour between these groups?

Disorders and behaviours featuring an impulsive component that were included in this thesis were reviewed in chapter two. The groups chosen were: children and adolescents with ADHD, women with eating disorders and recreational drug users. Children and adolescents with ADHD were chosen as impulsivity forms part of the DSM-IV criteria and there has been a move towards emphasising the impulsivity aspect of this disorder. Much of the research into impulsivity in ADHD however, had limited the measurement of impulsivity to either reports by parents and teachers or performance on the CPT. The second clinical population chosen were women with eating disorders. They were chosen because the DSM-IV criteria for bulimia nervosa specify that the eating binges are out of control. Furthermore research has suggested that impulsive behaviour, for some bulimics, is not restricted to their eating behaviour (Lacey & Evans, 1986). Women with restricting anorexia nervosa on the other hand have been characterised by control (Sohlberg, 1991) and studies have reported that women with anorexia nervosa score lower on impulsivity than controls (Casper, Hedeker and McClough,1992). The existence of anorexia nervosa with its over control and bulimia nervosa with its very tenuous control provide an illustration supporting the proposal that impulsivity, rather than being a discrete behaviour, varies along a continuum from self-controlled at one extreme to impulsive behaviour at the other. Consequently any thorough analysis of impulsivity should incorporate both clinical and non-clinical populations.

The chosen non-clinical group was recreational drug users, especially those who had used MDMA, known as 'ecstasy'. Previous research had reported that multiple substance abusers (McGown, 1988) had high levels of self-reported impulsivity, and that recreational ecstasy users had greater levels of self-reported impulsivity compared with non-drug users and non-ecstasy drug users (Morgan, 1998; Parrott, Sisk & Turner, 2000).

In addition to the populations included in this thesis having the common characteristic of problems with impulse regulation all, with the possible exception of ADHD, appear to be characterised by dysfunction of the serotonergic neurotransmitter system. In addition impulsive behaviour has also been linked with a deficient serotonin system, or postulated to be due to low levels of serotonin (Linnoila et al 1983). Although measures of either central or peripheral serotonin functioning were not assessed in this thesis previous research lends support to a serotonergic involvement of impulsivity, eating disorders, ecstasy use, and has been implicated in ADHD.

It is not suggested that problems with impulse control are the central and most important factor in maintaining all of these behaviours; rather it was considered that altered impulse regulation was an important aspect of what are, especially in the case of eating disorders, complex and multi-faceted behaviours.

The thesis attempted to resolve the issues raised above by using a variety of measures of impulsivity, including the development of a novel measure of risk taking behaviour, and by comparing the performance of the groups outlined above with appropriate control groups. The measures used included self-report (I-7, TPQ) and more objective measures (Bets-16, 'Hungry Kevin' & CPT).The results from these comparisons should enable conclusions to be drawn about the nature of impulsivity, the relationship between aspects of impulsivity, and the extent to which impulsivity is present in the groups included in the thesis.

The aims were (i) to assess whether the populations differed from controls in their performance on measures which were chosen to assess different aspects of the impulsivity construct, (ii) whether there were reliable and significant correlations between the measures, (iii) whether there were similarities between the targeted populations in their performance on the chosen measures of impulsivity and (iv) whether a measure of financial risk-taking behaviour was related to impulsivity and whether the targeted groups showed more risk-taking behaviour than controls. Two main issues arise from this research: (i) what do the patterns of impulsivity in these groups tell us about the disorders or behaviours and (ii) what do patterns of impulsivity in these groups tell us about impulsivity and the relationship between different aspects of impulsivity?

One issue highlighted at the end of chapter two was that there has been no general consensus on how to define impulsivity. Whilst the problem of defining impulsivity adequately has not been resolved within this research the issue was addressed by treating impulsivity as a multi-dimensional construct which can only be adequately assessed by using a variety of measures which either tap a narrow aspect of impulsivity (e.g. operant choice) or tap into more than one dimension (the I-7). The problem of definition may well be one that is never resolved, and no doubt the debate concerning how many factors, and what they are, that make up impulsivity will continue. This situation has parallels with personality theory where issues such as how many factors make up personality and what these factors are called continues to be debated. The problem of definition may cease to be an issue if impulsivity is viewed as a multi-dimensional construct, that for some is also a situation specific behaviour rather than an enduring trait. The research in this thesis has suggested that for some people impulsivity may be situation specific, and this may be one factor contributing to an explanation of the low correlations between measures of different aspects of impulsivity. However the one measure which did yield some consistent results between groups was the self-report trait measure of impulsivity, the I-7.

The findings from each measure of impulsivity across the different groups will be firstly summarised. This will be followed by a discussion of the correlations between measures. Finally the findings within each group on each of the measures will be summarised. Conclusions about the findings and how they relate to the groups will be drawn under the group discussions and not within the summary of the measures. This format is adopted to enable the issues raised above to be addressed.

9.1 Performance on a measure of risk-taking (Bets-16 test).

As outlined in chapter one risk-taking was postulated as a factor of impulsivity. Due to this the Bets tests (Bets-16 and Bets-17) were developed as a measure to assess risk-taking behaviour in the form of hypothetical gambles. This new measure of risk-taking was developed due to the limited availability of questionnaire measures of risk-taking, and the desire to use a more objective measure which was quick and easy to administer.

The series of studies on the Bets-16 and the Bets-17 tests were conducted to assess the reliability and validity of the Bets paradigm and to establish mean scores for males and females. Both the Bets-16 and Bets-17 had moderate test retest reliability and good internal reliability. The correlation with a self-report measure of risk-taking, the Everyday Risk Taking Inventory (ERI) assessed the convergent validity of the Bets-16, this was moderate but significant. The Bets-17 however did not show convergent validity with the ERI. On the basis of the studies with the Bets-16 and Bets-17, the Bets-16 was considered to be an appropriate measure to assess risk-taking behaviour and was chosen over the Bets-17 to be used in the research.

Bets-16 scores ranged from 0-16 with control groups typically having mean scores in the range of 4-5. Mean scores between males and females were not significantly different and both groups were scoring low, thus being risk averse. The range of scores recorded by the control group raised the possibility that this measure might be capable of detecting significant increases in risk-taking behaviour and possibly significant decreases also.

A brief summary of the findings on Bets-16 with each of the groups will be outlined below and then conclusions about what these results suggest about the Bets-16 as a measure of risk-taking behaviour will be drawn. The relationship of Bets-16 to other measures of impulsivity will be addressed separately after the findings of the measures have been dealt with, and this will enable conclusions about the relationship between risk-taking and impulsivity to be drawn.

Smoking and Bets-16

The percentages of 13 and 14 year olds in this research who had smoked cigarettes were similar to national statistics published by Jarvis (1997). Contrary to expectations the Bets-16 did not distinguish between groups of adolescent smokers and the group who made the most risky bets were those who had tried smoking at some stage, but were not current smokers. The number of risky bets chosen by the current smokers was comparable with the group who had never smoked. The findings of risk-taking as assessed by the Bets-16 test and smoking behaviour is not consistent with previous research with adult smokers. Smokers are considered to be risk-takers and impulsive by the nature of the smoking behaviour they engage in (Mitchell, 1999) and they have been reported as having higher impulsivity scores than non-smokers (Mitchell, 1999; Pritchard et al., 1992). The results from the Bets-16 with adolescents with different smoking behaviour suggests that smokers are either not financial risk-takers or that differences in adolescents attitudes to risk with smokers are not measurable by the Bets-16.

ADHD and Bets-16

A group of children and adolescents with ADHD made more risky choices on the Bets-16 than controls, therefore they were considered to be more risk-taking. The mean number of risky bets chosen by the ADHD control group in the study was lower than the means from the 13 and 14-year-old adolescents in the pilot study, however the age group of the participants without ADHD included a wider age range, with ages ranging from 9-16 years of age. Therefore the lower mean in the control group may have been due to age differences, and the inclusion of younger participants. The results on the Bets-16 test are consistent with predictions that individuals with ADHD would be more risk-taking.

Anorexia nervosa and Bets-16

Although the inpatients with anorexia nervosa were more risk averse than the controls, choosing more safe bets, the Bets-16 test did not differentiate anorexic inpatients from controls. These results suggest that the Bets-16 is not sensitive to decreases in risk-taking behaviour. The anorexic inpatients, anorexic outpatients and bulimic outpatients all had similar Bets-16 scores and all had a tendency to be more risk averse than controls. It was not anticipated that the bulimic outpatient group would demonstrate similar risk-taking scores to the anorexic inpatient group, however the sample of bulimic outpatients was low (n =5). Although a larger sample of outpatients would need to be recruited it appears that subgroups of eating disorders are not characterised by altered financial risk-taking.

Drug use and Bets-16 test.

Two out of the three individual drug use studies showed that ecstasy users were more risk-taking than the non-drug users, in that they made more risky bets. When the groups were merged to subdivide the ecstasy users into low, medium and high users on the basis of the number of occasions that ecstasy had been used, the high ecstasy users made more risky bets than the both the cannabis users and non-drug users. The findings of the bets paradigm also showed that as ecstasy use increased so too did the number of risky bets chosen. Again the Bets-16 demonstrated sensitivity to increases in risk-taking behaviour, which seemed specific to ecstasy users.

Conclusions of Bets-16 test.

The Bets-16 task does seem to be a valid tool with which to measure risk-taking behaviour in the form of gambles, although it did not discriminate between the anorexic inpatients and the control women. This may be a consequence of the low overall scores of the control group and therefore the Bets-16 is only sensitive to increases and not decreases in scores. This proposition is supported by the Bets detecting significant increases in risk-taking behaviour in both an ADHD group and ecstasy users.

The adult participants were not asked their reasons for making their choices on Bets-16, however the adolescents and children both with and without ADHD were asked why they made the choices they did. Those who chose the safe bets and were therefore risk averse, replied that they felt it was better to definitely win something, even if it was only a small amount rather than risk winning nothing. Those who made more risky bets claimed that they did so as there was only a small guaranteed win on the safe bet it was worth the risk of winning nothing to have the chance to win a larger amount. These reasons behind the choices given and the choices made both demonstrate different attitudes to risk.

The Bets-16 test discriminated between groups who have been identified as engaging in impulsive and risky behaviour; ADHD and ecstasy users. The Bets-16 therefore was able to detect significant increases in risk-taking behaviour in different groups who were also of different ages. It was not however sensitive to decreases in scores seen with the women with anorexia nervosa. This suggests that the detection of reduced risk-taking might require a task that generates higher levels of risk-taking among controls. The work in chapter four indicates this might be achieved by including more items with lower expected values as it was revealed that risky choices increased as the expected value decreased.

9.2 The I-7: empathy, impulsiveness and venturesomeness.

As noted in chapter three, the I-7 is a commonly used measure of impulsivity, containing two scales measuring different aspects of impulsive behaviour. Therefore the I-7 is viewing impulsivity as having at least two dimensions. As noted previously, the use of self-report measures can be open to response bias, and it is difficult to ascertain the honesty with which people reply to such measures. Despite this the I-7 was included due to its established reliability and validity and the wide range of age scores established. An additional advantage was that there is a junior version (I-6) for use with 8-15 year olds. The junior version, I-6, contains the same three scales as the I-7, although some of the questions differ between the two versions and the I-6 scales contain more items than the I-7.

The impulsiveness and venturesomeness scales were fairly reliable in detecting increases or decreases in scores between the groups.

Smoking, impulsiveness and venturesomeness.

Smoking was one behaviour that had been associated with higher levels of self-reported impulsivity, and Morgan (personal communication) suggested that the effects of nicotine on impulsivity were state dependent, induced by smoking, rather than due to an enduring personality trait of impulsivity. In the current research adolescents who had tried smoking had more self-reported (I-6) impulsiveness and venturesomeness than their peers who had never smoked, whereas the group of current smokers did not differ from either group on impulsiveness or venturesomeness. A group of ex-smokers also did not exhibit different levels of impulsiveness or venturesomeness from the other smoking groups. These results do not appear to support the trait theory of smoking and impulsivity as the group with the highest levels of trait impulsivity were those who had tried smoking rather than the current smokers. If impulsivity as measured by the I-7 was an enduring trait then both the current smokers and the ex-smokers would also be expected to have higher scores than a group who had never smoked. Morgan's theory of higher impulsiveness in smokers being state dependent was unable to be investigated because the length of time since a cigarette had been consumed in the current smoking group was unknown. The lack of differences detected between either the current smokers or the ex-smokers may have been due to small numbers in these groups and therefore there was not adequate power to detect a difference if one did exist.

ADHD, (I-6) empathy, impulsiveness and venturesomeness.

The studies in chapter 6 compared children and adolescents with ADHD, who were receiving psychostimulant medication, with age matched peers and found that the ADHD group had significantly higher I-6 trait impulsiveness scores than the controls. This is indicative of impulsive behaviour that is maladaptive in the disorder and leads to negative consequences such as exclusion from school and involvement in drug use. However the groups did not differ in terms of venturesomeness scores which measures the risk taking aspect of impulsivity. The ADHD group in addition to higher levels of impulsiveness reported lower levels of empathy compared with the control group. These results indicate that individuals with ADHD regard themselves as less likely to consider the possible negative consequences of impulsive behaviours but no more likely to engage in sensation seeking risky behaviour.

Eating disorders and impulsiveness and venturesomeness.

The second clinical population (chapter 7) included in the research were women with the eating disorders of anorexia nervosa and bulimia nervosa. Unfortunately insufficient numbers of women with bulimia nervosa were recruited so the analysis was limited to comparisons between inpatients with anorexia nervosa and controls. The anorexic inpatient group had significantly less self-reported impulsiveness and venturesomeness than age matched female controls. Interestingly the mean score from the five bulimic outpatients on impulsiveness was 7.2 compared with 7.0 for the anorexic inpatients, 9.0 for the anorexic outpatients and 10.5 for the controls. Thus on self-reported impulsiveness the bulimic group resembled the anorexic inpatients, and the anorexic outpatients showed more resemblance with the controls than with the anorexic inpatients. The anorexic inpatients had the lowest self-reported venturesomeness followed by the bulimic outpatients, anorexic outpatients and then the controls had the highest self-reported venturesomeness. The lower venturesomeness and impulsiveness scores by the anorexic inpatients compared with the control group were expected, as the disorder is characterised by controlled behaviour. Empathy was similar for all four groups. It had been aimed to assess the difference between anorexics and bulimics in this research as well as with controls, however due to the low numbers of bulimics recruited this was not possible. These results suggest that anorexic inpatients regard themselves as low on impulsivity and sensation seeking behaviours that involve risk (venturesomeness).

Drug use (ecstasy), impulsiveness and venturesomeness.

The studies with recreational drug users included two studies which incorporated the I-7, and the third study with the I-7 was an overall analysis pooling the data from both studies to investigate impulsiveness and venturesomeness in relation to drug use, especially the substance commonly known as 'ecstasy'. Levels of self-reported empathy were not different between any of the groups in chapter 8. However impulsiveness and venturesomeness scores were generally found to increase across groups from the non-drug users, to those who had only used cannabis, to polydrug users who had not used ecstasy to the ecstasy users. One of the studies found that ecstasy users had higher levels of impulsiveness compared with non-drug users. When the data from the two studies was merged to subdivide the ecstasy users into low, medium and high users on the basis of the number of occasions that ecstasy had been used, both the low and high ecstasy, and the polydrug users all had higher levels of impulsiveness compared to the non-drug users.

Drug use study one (8.1) found a significant difference in venturesomeness between groups of drug users, with ecstasy users reporting higher levels of venturesomeness than both non-drug users and cannabis users. The polydrug users also had higher venturesomeness scores than the non-drug user group. Results from the merged data found that both the low and high ecstasy users, and the polydrug users had higher levels of venturesomeness compared with the non-drug use group. The pattern seen with venturesomeness was that scores increased with the number of substances used and as the level of ecstasy use increased. The results from the individual studies reported similar findings to Morgan (1998) who also used a non-ecstasy polydrug user group and a control non-drug user group. The effects were that impulsiveness only appears to discriminate ecstasy users from non-drug users and does not appear to be general to all drug use. Increased venturesomeness, on the other hand, appears to be more characteristic of drug use in general and not restricted to ecstasy users, and in this case was able to discriminate single substance users (cannabis) and polydrug ecstasy users from non-drug users, and cannabis users from ecstasy users. However in the pooled data polydrug users had higher levels of both impulsiveness and venturesomeness compared with the non-drug users. The ability of venturesomeness to be more consistent in detecting differences between non-drug users and different groups of drug users, rather than just ecstasy users from the non-drug users, may be a reflection of venturesomeness measuring sensation seeking or thrill seeking risk-taking behaviour where a person is considered to be aware of the risks involved but engages in the behaviour regardless (Eysenck, S.B.G, 1993).

Conclusions on impulsiveness and venturesomeness.

The results from the different populations demonstrated that the self-report trait measure of impulsivity seemed to be a good discriminator between groups on impulsiveness and risk-taking behaviour (venturesomeness). This suggests that impulsivity may be a personality trait that leads people into risk-taking and dangerous behaviour.

Adolescents who had tried smoking had more self-reported impulsiveness and venturesomeness than adolescents who had never tried smoking. This is consistent with impulsivity being a trait that leads to risk-taking and impulsive behaviour. However those adolescents who reported being current smokers and who reported that they were ex-smokers did not differ from the non-smoking group. These non-significant findings may be due to the low numbers in each of those groups, and therefore they may not be an accurate indication of the relation between trait impulsivity and smoking. Alternatively the results may indicate that impulsivity is not a trait associated with smokers, but may reflect other personality or state dependent factors.

Venturesomeness did not differ between the controls and the ADHD group and this may be due to the behaviours that the venturesomeness scale assesses: venturesomeness deals with behaviours where the individual is aware of the risks and engages in the behaviour for the thrill of it. On the other hand impulsiveness assesses behaviour which is spur of the moment and an individual does not look ahead to the consequences of their behaviour. This is in line with the unplanned reckless behaviour that is seen in people with ADHD. In comparison anorexic inpatients are not impulsive and risk takers, according to their self-reports. Although anorexics clearly take risks with their health they do not regard themselves as either impulsive or venturesome and this was reflected in their lower impulsiveness and venturesomeness scores compared with control women. Drug use, especially ecstasy use, is associated with both impulsive and venturesome behaviour and this was reflected in the results.

These findings from the groups demonstrate that although there are potential problems with the accuracy of self-report questionnaires there were consistent expected findings from the I-7. Individuals with ADHD and drug users all regard themselves as being impulsive, whereas women with anorexia nervosa on the other hand, regard themselves as less impulsive. Drug users also regard themselves as more risk-taking with sensation seeking activities (venturesomeness), whereas individuals with ADHD do not compared with controls. Women with anorexia nervosa demonstrate the opposite pattern and regard themselves as less sensation seeking where the risks are known, despite the risks they clearly take with their health. The findings with the anorexics might reflect their blindness to the risks associated with their eating behaviour or the fact that the I-7 focuses on impulsive and risk-taking behaviour not related to eating. These results demonstrate that there are different profiles of self-reported venturesome behaviour (thrill seeking risky behaviour) between groups considered to be impulsive, but not in terms of impulsive behaviour where they fail to look ahead to the consequences of behaviour. Furthermore a group considered to be controlled (anorexics) showed decreased levels of both types of self-reported behaviour compared with a control group.

One issue which does arise from use with the current populations is that it is impossible to clarify what is cause or effect with both the anorexics and the drug users, as both starvation and drug use can lead to altered neurochemical functioning, which in turn can affect behaviour. Furthermore with the anorexic women are effects due to hospitalisation, as they were all inpatients on an eating disorder unit, and at what time period are they self-reporting? Another issue about self-report measures arises with the ADHD group who (all with the exception of one) were being treated on varying doses of psychostimulant medication. It is therefore difficult to say at which time period the ADHD group were self-reporting.

9.3 An operant choice paradigm: 'Hungry Kevin'.

An operant choice paradigm using delayed reinforcement had been identified as a useful measure to assess the inability to tolerate delay aspect of impulsivity. Various problems have been highlighted from previous studies using both children and adults on delayed reinforcement. Impulsivity in this task is defined as the choice of a smaller more immediate reinforcer over that of a larger later reinforcer, and self-control is defined as the choice of a larger later reinforcer over a smaller immediate one (Logue, 1988; Ainslie,1975). However in some previous studies, individuals who chose the smaller immediate reinforcer were classified as impulsive, even though their choice resulted in them receiving more reinforcement across the session (Logue et al.,1986) and it had been questioned whether such a choice in those circumstances was impulsive or adaptive.

Choice of the smaller immediate reinforcer in some studies resulted in a shorter session time (Sonuga-Barke, et al., 1996) and led Sonuga-Barke et al (1996) to suggest that such results demonstrate delay aversion rather than impulsive behaviour. However delay aversion, or inability to tolerate delay, can be considered to be an aspect of impulsivity. Some studies had attempted to overcome these issues, but what they resulted in was often equal length trials for the two choices and/or equal session lengths (Schweitzer & Sulzer-Azaroff.,1995) but not overall equal reinforcement rate for the two choices across the session. In such studies reinforcement densities were often confounded with session and / or trial length. The operant choice paradigm used throughout this thesis was designed to overcome the methodological problems associated with previous operant choice paradigms, so that reinforcement densities for the session overall were kept equal between the two choices as was session length. What therefore differentiated the two choices was the amount of pre-reinforcement delay received on each trial, the amount of reinforcement received on each trial, and the number of trials per session. As a result participants were left with a choice between many smaller immediate reinforcers or fewer larger later reinforcers. The current paradigm also used an immediately consumable reinforcer, access to a video game, which has been more effective in generating impulsive behaviour than the use of secondary reinforcers which are not delivered until the end of the session at the earliest. The delays and amount of reinforcement used with each choice, for the studies in this thesis, were selected based on previous work, so as to produce self-controlled behaviour. This then enabled increases, and potential decreases, in impulsive responding to be detected.

Unfortunately a large enough sample, in the adolescent pilot study, were not tested with the behavioural measure, 'Hungry Kevin' to investigate impulsive behaviour and smoking. The pilot study with the adolescents found that as the delay to the larger later reinforcer increased so too did the groups' preference for the smaller immediate reinforcer. More impulsive behaviour was displayed by the group who had a delay to the larger reinforcer of 42 seconds, compared with a group who had a delay of 18 seconds. However both groups displayed impulsive behaviour, which was unexpected in the 18 second delay group, based on previous findings with 'Hungry Kevin'.

ADHD and delayed reinforcement.

Both the control and the ADHD groups displayed impulsive behaviour in the operant choice paradigm 'Hungry Kevin', by showing a preference for the smaller immediate reinforcer over the larger later reinforcer, and the choice between groups was not significantly different. The ADHD and control groups did not display different latencies to make a choice response on the free choice trials, but it was the ADHD group who had the (non-significant) slower reaction times of the two groups. These results provide no support for increased discounting of delayed rewards or delay aversion among medicated ADHD children and adolescents.

Eating disorders and delayed reinforcement.

A similar pattern continued with 'Hungry Kevin' in that it did not discriminate between groups, the anorexic inpatients and the controls. The female control group showed a preference for the smaller more immediate reinforcer and thus displayed impulsive behaviour. The anorexic inpatients as a group tended to display indifference (mean = 48.8) in that there was neither a preference for the smaller immediate reinforcer nor the larger later one. In comparison the anorexic outpatients and bulimic outpatients both displayed impulsive behaviour on the operant choice paradigm. The anorexic inpatients and the control group did not demonstrate significantly different latencies to make a choice on free choice trials although the anorexic inpatient group did have a lower mean score, demonstrating a tendency for faster responding compared with the controls. The bulimic outpatient group also had similar response times to the anorexic inpatients on 'Hungry Kevin' free choice trials and the anorexic outpatients were the slowest to respond.

The operant choice paradigm was not used in the drug use studies due to the group methodology adopted for those studies.

Conclusions of an operant choice paradigm.

As mentioned above the current paradigm was chosen to overcome some of the problems associated with previous operant choice studies. The current schedules of reinforcement were used because they had typically demonstrated self-controlled behaviour in adults. However with the exception of the anorexic inpatients, who showed indifference, all groups of participants in this research displayed impulsive behaviour, and there were no between group differences. If nothing else the results were consistent, in that they demonstrated impulsive behaviour and consistently did not distinguish between groups. However previous studies which have demonstrated impulsive behaviour have not kept reinforcement densities equal between the two choices, and this may have actually resulted in the impulsive choice earning more reinforcement over the session in those studies. Consequently such behaviour could not be considered maladaptive and would rather suggest that it was an example of what Dickman (1990) termed functional impulsivity: choosing the smaller immediate reinforcer was advantageous in the long run.

An advantage that the operant choice paradigm used in this research had over previous studies is that reinforcement densities for the session were kept equal between the two choices. This ensured that choices were between a smaller number of larger later reinforcers and a larger number of smaller immediate reinforcers. Reliably choosing either the smaller or the larger reinforcers could not result in a shorter session length or more reinforcement. Consequently participants who preferred the smaller immediate reinforcer were demonstrating either a preference for shorter delays or a preference for smaller reinforcers. However the latter explanation seems unlikely because it would mean that longer access to the video game was less reinforcing than a shorter period of access. The possibility that participants may have found the longer playing time (40 seconds) aversive seems unlikely when comments made by participants are considered. When asked why they made a particular choice, participants who demonstrated a preference for the smaller immediate reinforcer, and demonstrated impulsive behaviour, said they did so as you did not have to wait for the game to restart. These comments therefore suggest that it was the waiting that was aversive in the self-controlled choice and not the longer playing time.

Forzano & Logue (1992) after reporting that participants showed impulsive behaviour when responding for juice available immediately suggested that "self-control may be, to at least some degree, situation specific" (p44). Their conclusion was drawn from the fact that adults show consistent self-control when responding for points exchangeable for money (Logue et al., 1986) but not when responding for juice that was available immediately. The difference in the results between Forzano & Logue (1992) and those of Logue et al., (1986), rather than being suggestive of self-control behaviour being situation specific may just reflect the different effect that secondary reinforcers have on behaviour. The use of secondary reinforcers, such as points exchangeable for money, in addition to the usual delays experienced before reinforcement is given and post reinforcement delays, also have a third delay, the delay to receiving and spending the money. The results of the current studies were in agreement with those of Forzano & Logue (1992), that responding for an immediately consumable reinforcer can generate impulsive responding.

These results of impulsive responding by all groups, except the anorexic inpatients, might suggest that the wrong schedules of reinforcement were chosen. Based on previous findings with the current schedule (Butler, unpublished; Montgomery, personal communication, 1997) this would not seem likely. Furthermore any reduction in the delay and reinforcement time associated with each larger later reinforcer trial would have to result in a reduction in reinforcement per trial associated with the smaller immediate reinforcer. Any reduction from the 10 seconds of reinforcement associated with the smaller immediate choice would surely then result in the smaller immediate choice becoming aversive due to the continued interruptions and post reinforcement delay experienced. The results may reflect that inability to tolerate delayed reinforcement is characteristic of all groups, controls and experimental groups, and does not differ between groups. Alternatively it may reflect situation specific impulsivity as Forzano & Logue (1992) suggested, and this issue will become clearer when the profile of the groups and the correlations between measures are addressed.

9.4 The continuous performance test (CPT).

This test was included in the assessment of impulsivity as it has been used with children and adolescents with ADHD, both in assessment for diagnosis and in the assessment of medication effects. The generation of both an inattention and an impulsivity score was considered useful for the ADHD population as it allowed comparison with other findings. The CPT was also considered to be a useful measure for the eating disorder population. Again scores of inattention and impulsivity were of interest, as was the generation of reaction time scores, as eating disorders are usually accompanied by depression, and depression can result in psychomotor retardation. These measures therefore allowed the possible link between a depressed state and reduced motor speed to be investigated. Piloting of a short form of the CPT with the ADHD and eating disorder groups was not considered to generate sufficient information. In addition the inclusion of a large number of target trials led to very few errors of omission and large numbers of errors of commission with the ADHD group. Therefore the commonly used AX version of the CPT was used for all the main studies.

ADHD and the CPT

The ADHD group had higher levels of inattention compared with the control group, this was indicated by increased errors of omission (i.e. failing to respond to the target on a target trial). Although the ADHD group also tended to be more impulsive, indicted by high errors of commission, there was not a significant difference between the two groups. An unexpected finding was that the ADHD group had significantly slower reaction times on errors of commission, thus they were not exhibiting a fast and inaccurate response, which is often characteristic of impulsive behaviour. When the ADHD group were responding inappropriately they did so slowly. In comparison the controls responded significantly faster to stimuli that were not targets than the ADHD group. This pattern, by the ADHD group, of having a tendency to be slower to respond was also seen with reaction times to targets (correct responses) although the two groups were not significantly different.

Eating disorders and CPT inattention and impulsivity.

Findings on the CPT from the anorexic inpatients and the control women showed that the anorexic inpatient group made significantly more errors of commission than the controls, indicating impulsive behaviour. Their reaction time to respond to non-target stimuli (errors of commission) was also significantly faster than the control group. These findings, of fast and inaccurate responding, are consistent with impulsive behaviour as suggested by Kagan (1966). It would be anticipated for this pattern to be seen in women with bulimia nervosa and not by those with anorexia nervosa. A higher percentage of the anorexic women (73.3%) made errors of commission compared with only 37.5% of the control women. Although not significantly different, the anorexic inpatient group also made more errors of omission, failing to respond to the target stimuli. The faster reaction times to non-target stimuli and a tendency to faster reaction times when responding to targets, seen with the anorexic inpatients, does not suggest that the high levels of depression seen in this group had resulted in psychomotor retardation.

The CPT was not used with the adolescents in the pilot study due to the licence only allowing the programme to be loaded onto one machine at a time, and was not used in the drug use studies due to the methodology employed in those studies.

Conclusions of the CPT.

The results from the two groups on the CPT showed some expected and some unexpected findings. Based on previous reports the higher errors of omission by the ADHD group were expected. Errors of omission are an inattention measure, and inattention is one of the core symptoms of ADHD. Therefore the finding supports that the current group were exhibiting inattentive behaviour, despite their medication. However the slower reaction times to non-target stimuli seen with the ADHD group were not expected. The ADHD group were expected to exhibit a fast and inaccurate style of responding and such a pattern of behaviour was not found. The slower reaction times to non-targets could represent inattention and this issue is explored further when the findings from the group are summarised. The ADHD group were not impulsive as measured by the CPT, and therefore did not demonstrate inability to withhold a response by responding to more non-targets.

The findings with the anorexic group were also not as expected: they displayed more impulsive behaviour, by making more errors of commission, with faster reaction times than the control group. The anorexic group were expected to be more controlled and make fewer errors of commission and have slower reaction times than the controls. No studies were found which had used a CPT with eating disorders, therefore comparison with previous studies are not possible. Possible explanations to the findings are discussed below in the group discussions.

9.5 The relationship between self-report and behavioural measures of impulsivity.

Consistent with the findings of Gerbing et al., (1987), Barratt & Patton (1983) and others, the correlations between the measures in this thesis were low and more often non-significant. Few significant correlations were reported and these were generally not consistently found from one study to another. Correlations with the adolescent group in the pilot study were only possible between the I-7 scales and Bets-16 test and this yielded a significant but low correlation between Bets-16 and impulsiveness. A positive correlation was also seen between Bets-16 and impulsiveness in a cannabis using group in drug use study 8.3. It would be more expected to find a correlation with the venturesomeness scale of the I-7 which is measuring risk taking behaviour in which a person is considered to be aware of the consequences. However as the Bets-16 is measuring financial risk taking, or the risk of the gamble, then perhaps the lack of correlation between a thrill seeking behaviour which involves risks is not a surprising find, as they are tapping different risk taking behaviour. It has been noted that the venturesomeness items are more related to sensation seeking and Zuckerman (1993) reported a correlation of 0.57 between an earlier venturesomeness scale (risk-taking) of Eysenck's and Zuckerman's sensation seeking scale. Venturesomeness could be considered to be measuring sensation seeking behaviour more than impulsive risk-taking behaviour, as the items which make up the venturesomeness scale are related to adventurous and sensation seeking sports and activities. As Zuckerman (1994) pointed out, sensation seekers are not necessarily impulsive.

However correlations were found more frequently between Bets-16 and venturesomeness than between Bets-16 and impulsiveness. Positive correlations were found between Bets-16 and venturesomeness in some of the groups in two of the drug use studies with undergraduates (8.3 & 8.4), and with the control group for the women with anorexia nervosa. With the exception of the ADHD study, Bets-16 correlated either with venturesomeness or impulsiveness but not with both. These correlations whilst being significant were usually low. Significant correlations were also found between TPQ novelty seeking behaviour and Bets-16 in two of the three drug use studies, again these coefficients were in the low range, but not unexpected. This pattern of correlations between Bets-16 and impulsiveness, venturesomeness, and novelty seeking suggests that the Bets-16 is tapping some aspect of impulsive behaviour.

In addition to the impulsiveness and venturesomeness scales of the I-7 showing correlations with Bets-16, they only correlated with other self-report scales. There was a positive correlation between impulsiveness and venturesomeness in the adolescent study, and in one of the drug use studies. Low correlations between the two scales have been reported by Eysenck et al (1985). There was a negative correlation between empathy and impulsiveness with the ADHD group and this reflects that the ADHD group scored high on impulsiveness and low on empathy. Other correlations of the I-7 scales were between TPQ scales. There was a negative correlation between harm avoidance and both impulsiveness and venturesomeness seen with undergraduates (experiment 7.1) and three of drug use groups in experiment 8.3. A positive correlation was also seen between novelty seeking and both impulsiveness and venturesomeness with undergraduates (experiment 7.1) and novelty seeking and impulsiveness in the final drug use study. These correlations were not unexpected as novelty seeking contains an impulsivity subscale and both novelty seeking and venturesomeness assess sensation or thrill seeking behaviours. Whilst correlations between self-report scales and objective measures of impulsivity have not usually been found, correlations between self-report scales have been reported previously.

Scores on the continuous performance test tended to correlate with other CPT measures. However with the ADHD and control group and the anorexic inpatients and control women CPT scores correlated with other measures. With the control group in chapter six there was a negative correlation between errors of omission and hit reaction time. This indicates that those who responded to targets faster also missed more target stimuli. The ADHD group in chapter six showed correlations between errors of omission and Bets-16 which reflects that the ADHD group were more risk taking on the Bets and more inattentive. Errors of commission correlated with impulsive choice responding on 'Hungry Kevin'. Impulsive responding on 'Hungry Kevin' also correlated with hit reaction time. Therefore those individuals with ADHD who were more impulsive on the

CPT were also more impulsive on 'Hungry Kevin' and responded slower to target stimuli. Hit reaction time also showed a positive correlation in the ADHD group with venturesomeness. Fast responding and risk taking behaviour are consistent with the behaviour of an impulsive person.

The correlations from the anorexic and control groups (chapter 7) showed five significant correlations between CPT scores. For the control group of women there was a negative correlation between the number of commission errors and hit reaction time. This indicate that a person who responded in error, to non-targets, did so rapidly, thereby demonstrating a pattern of fast and inaccurate responding. There was also a negative correlation between hit reaction times and errors of commission reaction times, showing that those who responded rapidly to non-targets responded slow to target stimuli. The third correlation with the anorexic controls was a negative one between Bets-16 and errors of commission reaction time. This again demonstrates that those who were risk taking were also demonstrating a fast response style.

The two significant correlations with the anorexic women were between Bets-16 and errors of omission and errors of commission reaction time and venturesomeness.

The lack of correlations between the CPT impulsivity score, errors of commission, and the other impulsivity measures, with the exception of the correlation with impulsive choice responding on 'Hungry Kevin' in the

ADHD group, either reflects that such a measure of impulsivity is not related to self-report impulsivity, risk-taking, and possibly behavioural impulsivity of delayed reinforcement, or that the type of commission errors the groups are making reflect inattention (as suggested by Halperin et al, 1991) rather than impulsivity.

In keeping with previous research, which very infrequently report correlations between self-report and behavioural measures, no correlations were reported between the self-report scales and the operant choice paradigm ('Hungry Kevin'). Neither were there any correlations with the operant choice paradigm and Bets-16. The only two significant correlations in the entire thesis with impulsive choice responding on 'Hungry Kevin' was with CPT hit reaction time and errors of commission in the ADHD group. Previous research with operant choice paradigms has usually used the task in isolation from other measures of impulsivity. In light of findings in the present research, this raises the issue of whether the operant choice paradigm's measure of inability to tolerate delay/ delay gratification is actually a good task for measuring this aspect of impulsivity in humans. The studies did however find that all groups, with the exception of the anorexic inpatients (who demonstrated indifference for either choice) displayed impulsive responding. This is not consistent with previous research which has generally found it difficult to generate impulsive behaviour in humans, with the exception of certain populations. Furthermore it may be that impulsive behaviour or self-controlled behaviour is much more situation specific than previously thought. It is documented, for example, that ADHD children's behaviour will vary from situation to situation and they can be very attentive and controlled when on a one to one basis and with a person with whom they are not familiar (Goldstein, 1998). It seems that the operant choice paradigm used in the present research can detect discounting of delayed rewards but performance on this measure does not appear to be associated with any of the other measures used in this thesis. This reinforces the idea that impulsivity is multi-dimensional and that different aspects of impulsivity might function independently.

There are several points that need to be raised about each of the self-report and behavioural measures. Self-report measures, by their nature, measure the person's own view of his or her self. This raised issues with its use with the individuals with ADHD who were on psychostimulant medication. To what period did their self-reporting refer? Was it as they were at the time of testing, how they are when on the medication or how they are when they are not under the effects of the medication? Whilst answers to these questions were not requested and therefore are unknown, it is a valid question to ask when using clinical groups who have their behaviour 'controlled' or modified by psychoactive agents. Furthermore as the time between medication and testing, the daily dose and dose at each time varied greatly between participants, a general effect of medication can not be clarified. Such issues can also be raised with the anorexic as effects seen could be due to starvation and/or hospitalisation.

An advantage to some of the self-report questionnaires, and of the I-7 used in this research, is that they are measuring a broader view of impulsivity than many of the behavioural measures, which often measure a narrow aspect. That is, they are treating impulsivity as a construct with more than one aspect or factor to it. This is achieved by the self-report questionnaires having 2 or more scales that have been subjected to factor analysis. In the case of Eysenck et al., (1985) impulsivity is made up of only two dimensions.

The issue of whether impulsivity is viewed as a uni-dimensional or multi-dimensional aspect has been one of the factors that has been proposed to explain the low and non-significant correlations between the self-report measures and within the behavioural measures. Although Eysenck & Eysenck (1991) report low correlations with their two factors of impulsivity, just because they are measuring the same construct it does not mean that there will necessarily be any correlation between the different factors. This was borne out in the current research where impulsivity was treated as a multi-dimensional construct and a variety of tests were used which were believed to capture different aspects of impulsivity. Even though some groups displayed impulsive behaviour on more than one aspect the correlations between the measures were either non-significant or if significant they were low. Furthermore the correlations that were present in one group were not present in other groups, and so consistent correlations were not found. The correlation that was the most consistent across groups was between Bets-16 and venturesomeness, and is contrary to previous findings of reasonably inconsistent correlations between self-report and behavioural measures of aspects of impulsivity. These results suggest that the Bets-16 is a robust task that has some reliable correspondence with one aspect of impulsivity, but overall impulsivity appears to be a multi-dimensional construct.

Summaries of the findings on each group and what the results tell us about impulsivity in these groups will be discussed.

9.6 ADHD summary.

An unanticipated finding from the ADHD group was that they showed less self-reported empathy than controls. As noted previously lower empathy in those with comorbid conduct disorder would not be surprising as this is a disorder in which social norms and the basic rights of others are violated. None of the current group of children and adolescents however had comorbid conduct disorder. DSM-IV associated features of conduct disorder states that "Individuals with conduct disorder may have little empathy and little concern for the feeling...of others (DSM-IV, 1994:87). Fasnatch-Hill (2001) however found no difference on empathy between adolescent males with CD, ADHD and controls. The study of Braaten & Rosen (2000) found that boys (aged 6-12.8 years) who met the DSM-IV diagnostic criteria for ADHD hyperactive/impulsive type or combined type responded with less empathy than non-ADHD boys on an empathy response task, however the groups did not differ on self-report measures of empathy, emotional intensity or emotional reactions. The findings from the current study are therefore not consistent with the results of either Fasnatch-Hill (2001) or Braaten & Rosen (2000) and there appears to be no valid explanation for the findings. Some of the ADHD children and adolescents who had the questions read out to them gave responses to some questions which suggested that they thought it was either a silly question or they appeared surprised as to why, for example you would feel sorry for a lonely stranger. They appeared to be able to feel empathy with their own family and friends on some issues, but not with people with whom they had no emotional attachment. These findings warrant further research into empathic responding in children and adolescents with ADHD.

On the continuous performance test (AX version) the ADHD group showed the usual higher number of errors of omission, which are considered to reflect inattention, compared to the control group, and is consistent both with previous research (Johnson, et al., 2001; van Leeuwen et al.,1998) and with inattention being one of the core symptoms of ADHD. The ADHD group did not however differ from the controls on errors of commission, which are considered to be a measure of impulsivity. This may be a consequence of the slower reaction times on errors of commission displayed by the ADHD group, and demonstrates that in the current research when ADHD individuals responded inaccurately they did so slowly. The pattern of fast and inaccurate responding that was used by Kagan (1966) to characterise impulsives is not evident here. Although the ADHD group did not respond to significantly more non-targets than controls, they did respond significantly slower to the non-targets, and responded to significantly fewer targets than the controls. Therefore they were more inattentive, but not more impulsive and fast to respond.

The operant choice paradigm did not yield any significant differences between groups, and both groups were impulsive, in that they chose the smaller immediate reinforcer more often across the session than the larger later choice. It may be that in a game situation there were no differences between the two groups in terms of their ability to tolerate delays or delayed rewards. The inability to tolerate delay or await ones turn that are typical of individuals with ADHD may be an enduring characteristic whereas for the controls this may reflect situation specific or state impulsivity. The reasons given by participants for making the choices that they did on free choice trials were the same for both groups, i.e. that the game started quicker, or they did not have to wait. It thus seems that both groups found waiting in that situation aversive. It also cannot be said that the ADHD group were making quick decisions as their latency to button press was comparable with the control group and there was not a significant difference between the two groups.

The ADHD group demonstrated higher impulsiveness scores on the self-report I-7 scale, which is measuring impulsive risk-taking behaviour where the consequences of behaviour are considered. This measures behaviour that is characterised by an inability to look ahead to the consequences of behaviour. The ADHD groups were also more financially risk-taking, measured by making more risky bets on the Bets-16 test: they demonstrated more of a preference for the long shot at winning a larger amount, rather than a certain win of one of two smaller amounts. There was no difference on the venturesomeness scale of the I-7, as outlined above this may be due to the risk-taking behaviours it measures being of the sensation seeking type. It seems that just because an individual takes risks by behaving impulsively it does not mean that they would choose to take risks by engaging in sensation seeking sports and activities. As noted in chapter 1, although most impulsive behaviour has an element of risk to it, not all risk-taking behaviour is impulsive, as Zuckerman (1993) points out many of the risky sensation seeking activities actually require careful planning and thought.

The results from the ADHD group demonstrate: (i) that they perceive themselves as impulsive, and self-report high levels of impulsive behaviour that is characterised by not looking ahead to the consequences of behaviour, (ii) they are financial risk-takers, (iii) but would not engage in sensation seeking and risk-taking activities that have an element of danger about them, (iv) they are low on self-reported empathy, (v) they are inattentive, (vi) slow to respond inaccurately, (vii) and they are also unable to tolerate delays or delayed reinforcement (but so were controls). The overall profile is one of higher self-reported impulsive behaviour, and risk-taking behaviour than controls, less empathic than age matched peers, they do not delay reinforcement but that is not specific to ADHD and are more inattentive and slower to respond accurately than their peers, which may also reflect inattention. The one aspect of impulsivity which the ADHD group did not display was inability to withhold a response to non-target trials on the CPT. The ADHD group were medicated and these non-significant differences may reflect aspects of behaviour that the medication was having an effect upon, whereas the differences in impulsiveness, risk-taking and inattentive behaviour may either remain unaffected by medication or persist at high levels despite medication.

9.7 Eating Disorders and impulsivity.

The anorexic inpatients displayed a significantly higher levels of self-reported depression, which is consistent with previous research (Bulik, 2002). The CPT found anorexic inpatients making more errors of commission, responding to non-targets, compared with the control females. This was not anticipated because this is usually regarded as an index of impulsivity. However as outlined in chapters 6 and 7 Halperin and colleagues have suggested that only certain errors of commission on the AX paradigm represent impulsivity, whereas others represent inattention. Although the current AX paradigm does not give analysis of the different types of errors of commission one possible explanation for the findings could be that the errors they were making were of the inattention type. However if the anorexics were making errors considered to be measuring inattention then it could reasonably be expected for them to also make more errors of omission, failing to respond to targets, which is considered an index of attention (Conners, 1995). This however was not the case.

In addition to responding more to non-targets, the anorexic inpatients also responded faster to non-targets than the control group. This is how impulsives have been characterised by Kagan (1966), as emitting rapid and error prone responding. What the results demonstrate is that the anorexic inpatients responded quickly and inaccurately. This was unexpected given that anorexics have been found to be controlled and rigid, and they also displayed significantly higher levels of depression in comparison with the control group. The anorexic inpatients reaction times to CPT targets and latency to respond in 'Hungry Kevin' were comparable to the control group. Therefore the results seem to indicate that anorexic inpatients showed behavioural impulsivity.

As regards the operant choice paradigm, 'Hungry Kevin', if nothing else the results were consistently non-significant between the groups. The control group displayed impulsive behaviour across the session, making more choices of the smaller more immediate reinforcer. The anorexic inpatients as a group showed indifference but their choice behaviour was not significantly different from the control group. Again those who chose the smaller more immediate reinforcer in both groups gave similar reasons, indicating that it was either due to disliking the delay associated with the larger later choice or wanting to get back to the game.

The anorexic inpatients were not significantly different from the controls on the number of risky bets that they chose, although they had a tendency to be more risk averse. As mentioned previously it may be that the Bets-16 test is not sensitive to decreases in scores, only increases. This is highly probable given the low mean score, in the present study, also of the control group. Although anorexics have been characterised as being cautious, it could be suggested that the nature of the disorder is not entirely indicative of cautious behaviour, as it is undeniable that self induced starvation is associated with many health risks, including death. The significantly lower scores of the anorexic group, on both self-reported impulsiveness and venturesomeness, are consistent with previous findings.

Determining whether these are trait or state dependent (starvation dependent) effects would require either a longitudinal prospective study, or require testing at admission to a unit for re-feeding and testing at discharge, and/or testing again at recovery. Due to constraints of time this was not possible in the present study. However it is difficult to specify what constitutes recovery in anorexia nervosa and at discharge it would be unlikely that recovery was complete, rather weight gain had been achieved and remission had occurred or recovery had begun.

Conclusions with the anorexic inpatient sample show a profile of: (i) a self-reported depressive state, (ii) they perceive themselves as self-controlled as they self-report low levels of impulsive behaviour that is characterised by not looking ahead to the consequences of behaviour, (iii)they would not engage in sensation seeking and risk-taking activities that have an element of danger about them, therefore they are risk and thrill averse, (iii) and they are not financial risk takers and demonstrate high financial risk averse behaviour, although not different from the controls. Some of the behavioural tests (CPT) revealed a different pattern, and this was one which suggested fast and inaccurate responding and which was faster and less accurate than the control group, and can be classified as impulsive behaviour. The discrepancy in the results between the self-report measures of impulsivity and the behavioural measure may be due to anorexics perceiving themselves as being controlled but their behaviour on withholding a response suggests otherwise. Such findings could be explained if the sample consisted largely of bulimic anorexics (anorexics who also binge) as they have been described as frequently displaying other impulsive behaviour(s) and are a group who discharge impulses through action (Garfinkel, 2002). All of the current anorexic group however were considered to be restricters. Higher levels of self-report impulsivity in an anorexic sample were reported by Askenazy et al. (1998), on the IRS which assesses behaviour in usual life situations. However Askenazy et al (1998) note that although the IRS is self-report, impulsivity as assessed by the IRS is strictly behavioural. These results suggest that how anorexics perceive themselves and how they behave in certain situations are in conflict with each other.

9.8 Illicit drug use and impulsivity and risk-taking.

The studies on recreational drug use and impulsivity, had focused specifically on ecstasy (MDMA) use as studies have suggested that the substance is a neurotoxin and ecstasy use leads to depletion of the neurotransmitter serotonin, and low levels or dysfunction of serotonergic systems have also been implicated in impulsive behaviour.

Undergraduate students were chosen as they reflected the age group of adults who are the main users of recreational drugs. The relationship between substance use, impulsivity and risk-taking behaviour was investigated with a series of three studies and then an overall analysis merging the data. Only pencil and paper tasks were used for these studies so that data could be collected in a group situation. It was felt that participants would feel more anonymous in a group situation than on a one to one basis, which would have been required for completion of the computer tasks. This greater anonymity was considered to be advantageous in eliciting honest answers from participants about their drug use, as it was acknowledged that this was a sensitive issue asking about an illegal act. Coomber (1999) suggested that collection of sensitive data such as drug using behaviour in groups who are asked not to talk whilst filling in questionnaires and sit apart from their colleagues means that respondents are not under pressure to conform or exaggerate to perceived norms.

Although up to this point 'Hungry Kevin' had not discriminated either of the clinical groups from the non-clinical controls, discounting of delayed rewards has been reported by substance abusers (Crean & de Wit, 2000). Therefore it may have been a useful measure to have used with the drug-using group. Unfortunately due to the group data collection to allow for greater anonymity and, also the recruitment of large numbers of participants, meant it was not feasible to give 'Hungry Kevin'.

The series of drug use studies found that ecstasy users had higher levels of self-reported impulsiveness and venturesomeness behaviours than the group of people who reported never having used an illicit substance. The ecstasy users also scored higher on venturesomeness than the cannabis users in the first study. Similar results were seen with the Bets-16 test: the ecstasy users were more risk-taking than the non-drug users. These results on the Bets-16 were seen in two of the three studies.

The two studies using the TPQ only revealed differences between the groups on novelty seeking, with the ecstasy users displaying more novelty seeking behaviour than those who had never used illicit substances. The polydrug users also displayed higher novelty seeking behaviour in study 8.3 compared with the non-drug users. Novelty seeking behaviour did not differ between groups who had used one or more illicit substances. These findings are consistent with research that suggests drug use is a sensation seeking behaviour, and the findings of Gerra et al., (2000) and Schifano (2000) who reported higher levels of novelty seeking behaviour in ecstasy users compared with controls, but no differences between the groups on either harm avoidance or reward dependence.

In the final study, the data from the three drug use studies were merged to enable the ecstasy users to be split according to lifetime use of ecstasy, and to investigate whether there was a difference between the number of times that ecstasy had been used and impulsivity. It was found that as the lifetime use of ecstasy increased so too did self-reported impulsiveness, venturesomeness, and financial risk-taking behaviour. Furthermore the increased impulsiveness and venturesomeness do not appear to be specific to ecstasy use, but to all polydrug use as the high and low ecstasy users and the polydrug use groups all showed significantly higher levels of self-reported impulsive and venturesome behaviours. In contrast significantly higher financial risk-taking behaviour was limited to the high ecstasy users. These results may reflect that as a person increases their use of ecstasy they increase their risks in many domains - financial, social and health.

The three groups of ecstasy users showed a similar pattern on novelty seeking behaviour to impulsiveness and venturesomeness, with novelty seeking scores increasing with lifetime use of ecstasy. The polydrug users, low ecstasy users and high ecstasy users again all displayed more novelty seeking behaviour than non-drug users. Again no group differences were seen on either harm avoidance or reward dependence, or between the groups of ecstasy users and other drug users.

Whilst the groups of drug users did have a tendency to have lower levels of harm avoidance than the non-drug users differences were not statistically different. Previous research has found that drug using groups have higher novelty seeking behaviour and lower harm avoidant behaviour, which fits with the pursuit of heightened arousal through the use of illegal and potentially harmful substances.

Overall these studies revealed a person who has used multiple substances as having the following profile: (ii) perceives themselves as impulsive, (iii) engages in sensation seeking activities that have an element of risk, (iv) and self-report that they seek novel experiences. Higher levels of financial risk-taking were restricted to ecstasy users, and especially to those with a higher lifetime use of the substance. The series of studies also highlighted that significantly more ecstasy users, than polydrug non-ecstasy users, had also used the substances amphetamine, cocaine and LSD. This obviously raises the issue of whether differences in impulsivity and risk-taking behaviour were a consequence of ecstasy use or due to one of the other substances or an additive effect of the poly substance use. Another issue is that impulsivity may predate the polydrug use, be a cause rather than a consequence. These are questions that can only be answered with longitudinal prospective studies. Furthermore it is impossible to ascertain the accuracy, or honesty, of the participants self-reported drug use.

9.9 Concluding remarks, methodological issues and future research.

The studies in this thesis yielded some consistent results and some non-consistent results. Consistent results were that significant group differences were not seen on the operant choice paradigm, as all groups with the exception of the anorexic, were impulsive. A measure of financial risk-taking behaviour, which was further developed yielded consistent results in detecting increases between groups in financial risk taking, but was not able to detect significant decreases between groups in risk taking behaviour. These studies suggest that it is a valid tool to measure risk taking behaviour, and in some groups shows an association with impulsive and/or risk taking behaviour which is sensation seeking in nature.

Another consistent finding was the self-report measure, the I-7, discriminated between groups, either in terms of impulsiveness and/or venturesomeness. The result from these studies either suggest that these measures are tapping into different aspects of impulsivity which are not correlated, or that the experimental groups chosen do not display impulsive behaviour consistently across situations. Thus suggesting that rather than being a stable personality trait across situations and time, impulsivity is best viewed as being situation specific for some people, because impulsive behaviour may be exhibited in a narrow range of situations whereas for others it may manifest itself in a variety of situations, and impulsivity for them may be an enduring trait across situations. The lack of correlations has highlighted the multi-dimensional nature of impulsivity.

The research on impulsivity could be extended to use more than one self-report questionnaire, as despite the problems with using such measures, it was the one measure with reasonably consistent findings. Furthermore additional behavioural tasks could be included, such as time estimation and reproduction, although such behavioural measures are also only assessing a narrow aspect of impulsivity and have consistently been found to show no correlation with other measures of impulsivity. The strengths of this research is that it used measures which were independent of time of response, although two reaction time measures are generated by the CPT and one by 'Hungry Kevin', which can be a confounding variable when used with groups who are depressed or receiving treatment with psychoactive substances. Also the present research included both self-report and behavioural measures of impulsivity, which were believed to tap into different aspects of the construct. Whilst the results have not resolved the ambiguity in how to define and measure impulsivity, rather it has probably served to highlight the complex nature of impulsivity, thus indicating that the search for the elusive definition and the absolute measures of impulsivity requires further research.

Future research could assess the types of behaviours that impulsive people engage in, such as those asked by Lacey & Evans to test for their multi-impulsive personality, and give a wider range of tests. However in this current research, time constraints restricted how many tasks could be given in any one session and it was deemed impractical to give tasks across two or more sessions to either group or participants. The recruitment of a larger sample of anorexics and bulimics would enable comparisons between the subgroups of eating disorders and testing all inpatients within the first two weeks of admission would constitute a more homogenous group in terms of severity and starvation effects. To investigate the effects of starvation on the behaviour of anorexics testing at admission and then again at discharge, after some level of weight gain had been achieved could assist in answering whether the effects are state or trait dependent.

Again the question of state versus trait impulsivity in individuals with ADHD could be investigated by a longitudinal study, however such studies are time consuming and costly. Also the effects of psychostimulant medication on impulsive behaviour can only be investigated by assessing individuals when medicated and during a period of non-medication. This had not been possible in the current research due to the participants not having a drug free period. This then poses difficulties for investigating the effects of medication, and the withdrawing of medication for research purposes raises obvious ethical issues. A sample of non-medicated ADHD participants could be an alternative, although such a sample had been sought and was not recruited. The other issue as noted when using populations who are treated with psychoactive substances is what time period are they reporting on self-report questionnaires, especially if an effect of the drug is to lower impulsive behaviour. This is also an issue in research with women with eating disorders, again are they reporting in their emaciated state, and usually depressed state, or are they reporting as they were prior to the onset of the disorder, or at normal weight? This brings us back to the issue of whether impulsivity is a stable personality trait across time and situations for all or some people, or whether it is a situation specific state and for some people impulsive or self-controlled behaviour is limited to one or two situations whereas for others it is manifest in a variety of different situations. The populations used in this research could all have altered behaviours either due to the use of psychoactive substances, as prescribed medication or as a recreational substance, or due to altered brain functioning due to the effects of starvation. Questions about whether impulsivity reflects a state or a trait would require longitudinal research. Such issues are of importance in treating disorders where impulsive behaviour exists. As merely treating the effects of impulsive behaviour (binge eating, drug use) and not the behaviour itself, will not result in a reduction in impulsive behaviour and may lead to more problems in the future for the individual.

In conclusion, as Coles (1997) notes "A solution has never been found to a problem that was never defined." (p192). Coles goes on to note that until the concept of impulsivity is clearly defined then classification of DSM disorders and the guidelines for treatment will vary from the non-existent to the confused.

Although the problem of defining and measuring impulsivity will continue, until impulsivity is considered as an important aspect of the disorders and the implications impulsive behaviour has in treatment, then merely defining impulsivity, whilst being a step forward, will not ensure that problems with impulse control are addressed either in diagnosis or treatment.

Research on impulsivity needs to continue to use a variety of measures and populations where impulsive, or self-controlled, behaviour is present. Furthermore impulsivity needs to be treated as a multi-dimensional construct and future studies must acknowledge this and test each dimension independently, and researchers need to be more specific about what is meant by impulsivity. In addition, as more biological indices of these disorders and behaviours comes to light then a common biological basis, which is implicated, may unravel to link these impulsive behaviours and disorders. However the neurotransmitter systems are themselves complex systems which do not function in isolation from each other. Furthermore different researchers investigating impulsivity need to draw on the work from the different areas more and not continue to view impulsivity within a narrow field. Only when all of these factors are taken into consideration can a greater understanding of the construct of impulsivity hope to be achieved.

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Appendices

Appendix I	Bets -16 (unpublished).
Appendix II	Bets-17 (unpublished).
Appendix III	Everyday Risk Inventory (ERI; Steketee & Frost, 1994).
Appendix IV	Impulsiveness, venturesomeness & empathy questionnaire, junior version. (I-6; Eysenck et al, 1984).
Appendix V	Smoking questionnaire (unpublished).
Appendix VI	Impulsiveness, venturesomeness & empathy questionnaire, adult version. (I-7; Eysenck et al. 1985).
Appendix VII	Tri-dimensional Personality Questionnaire, 54 item (TPQ, Heath et al, 1994).
Appendix VIII	Eating attitudes test (EAT-26; Garner et al., 1982).
Appendix IX	The Bulimic Inventory Edinburgh (BITE; Henderson & Freeman, 1987).
Appendix X	Beck Depression Inventory (BDI; Beck, et al., 1961).
Appendix XI	Drug Use Questionnaire (unpublished).

Appendix I

Bets-16

This test requires you to make choices between pairs of imaginary bets which are represented in a pie chart format (see next page).

For each bet you should imagine there is a pointer in the centre of each circle. This imaginary pointer can be spun and you would win whatever amount is written in the section the pointer lands on. To make this clearer there is a practice trial at the bottom of this page.

In this example if you choose Bet A there is a 50%, or 1 in 2, chance that you would win £10,000 and a 50% chance that you would win nothing (£0). Alternatively if you choose Bet B there is a 25%, or 1 in 4, chance that you would win £15,000 and a 75%, or 3 in 4, chance that you would win nothing (£0).

On the following pages there are sixteen more pairs of bets, all you have to do is choose which bet from each pair YOU would rather take. Please circle either A or B to indicate which bet is YOUR choice.

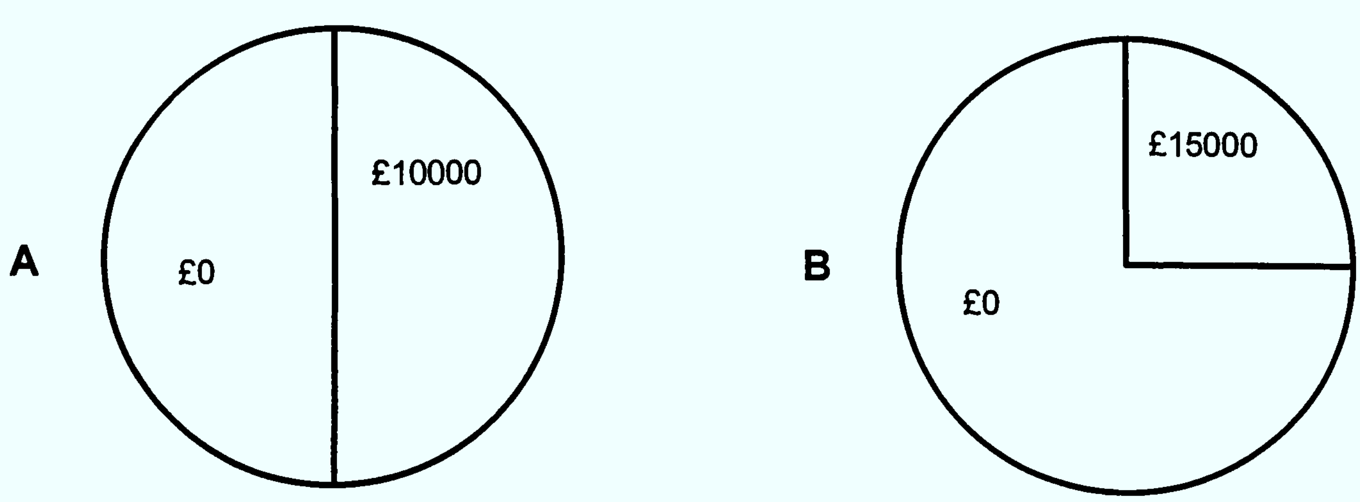
You will notice that for each pair of bets one choice offers a certain win, but the other choice offers the possibility that you will make either a bigger win or win nothing (£0).

There are no right or wrong answers, we are only interested in your personal preference. Please try to answer as if you were making a choice between real bets.

Remember, for each pair of bets circle either A or B to indicate which you prefer.

Thank you.

Practice



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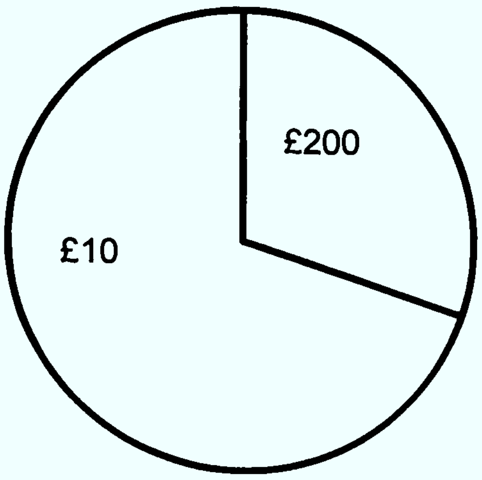

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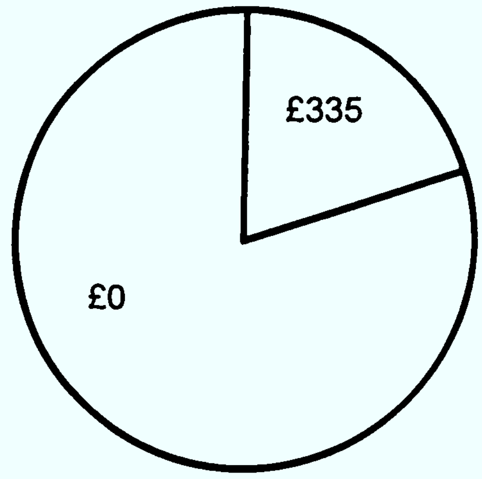

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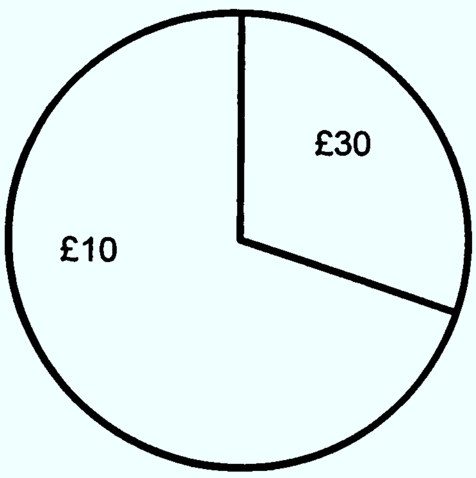

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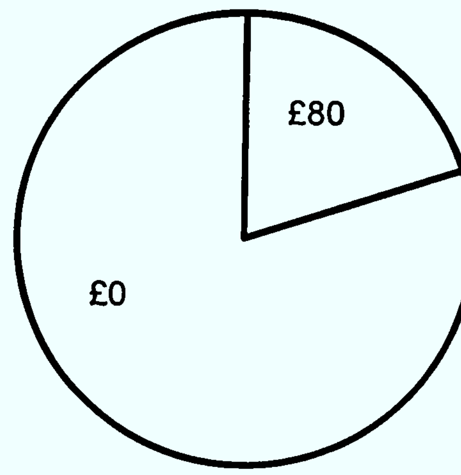

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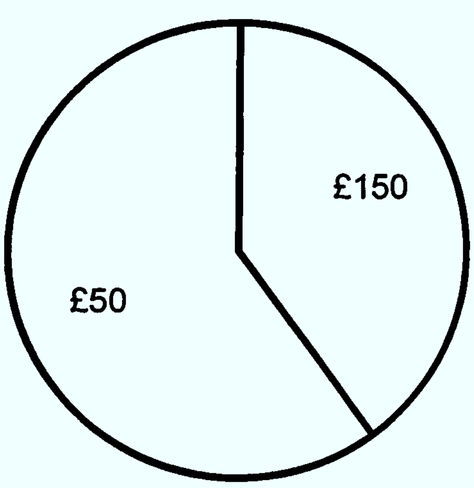

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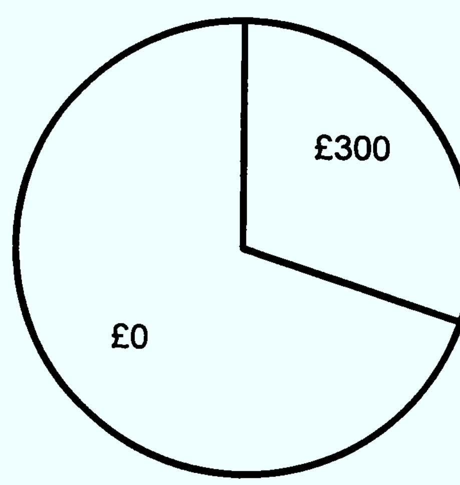

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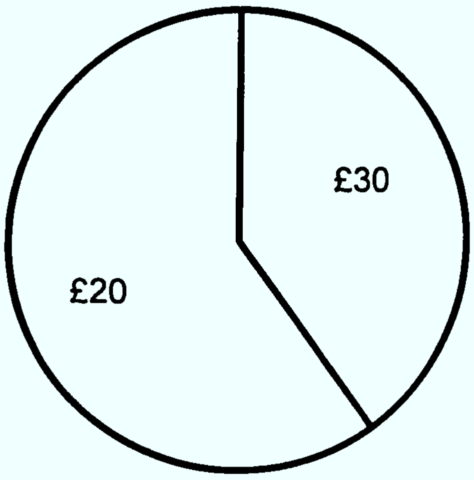

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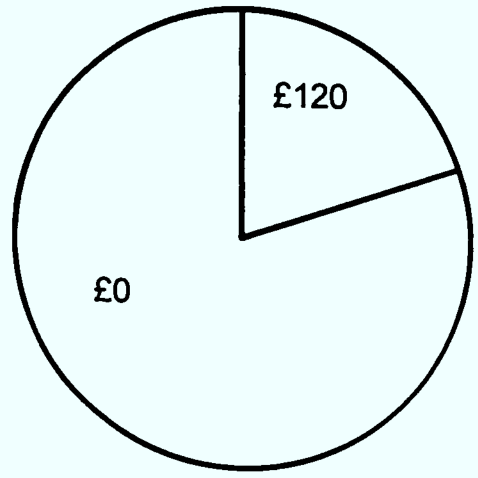

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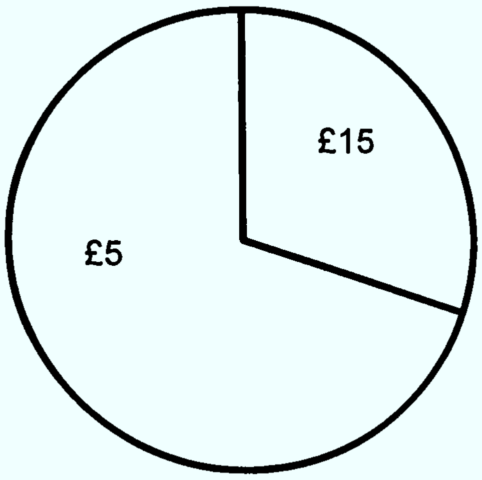

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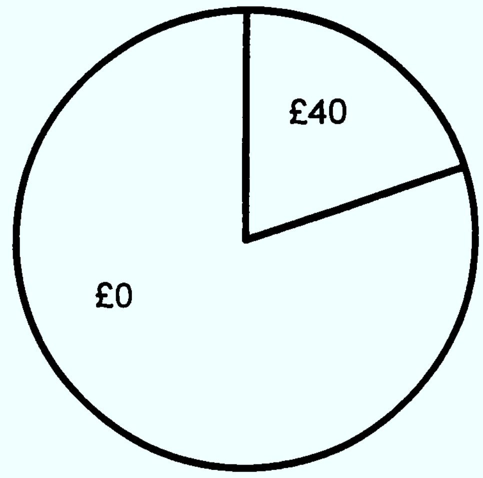

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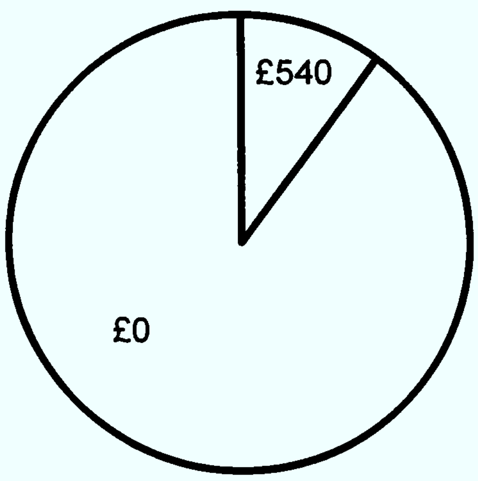

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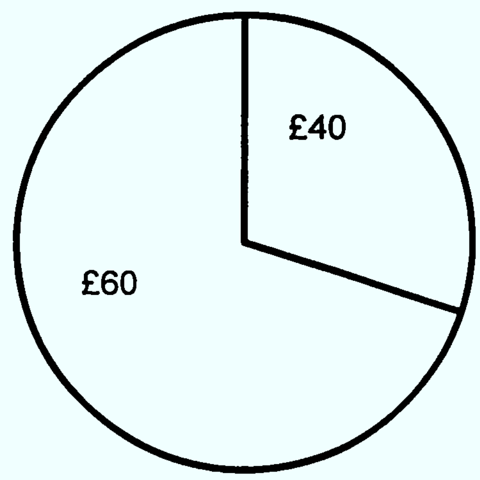

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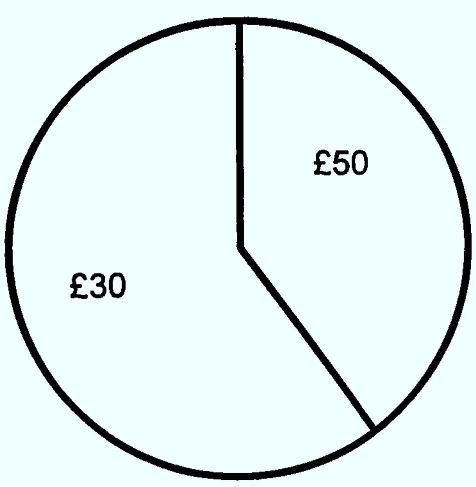

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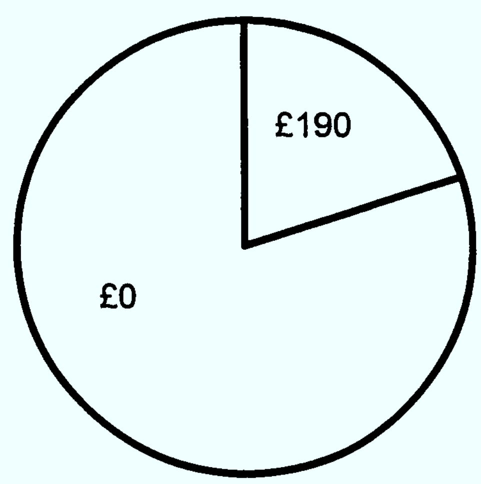

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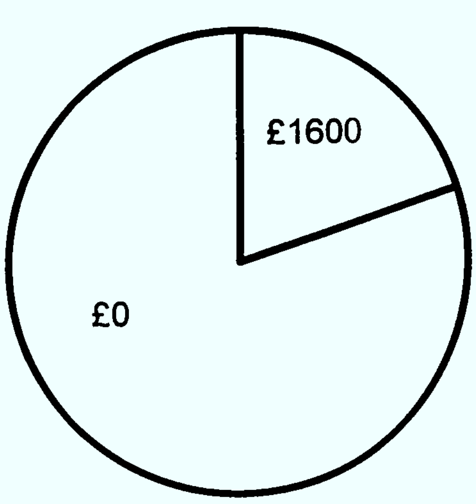

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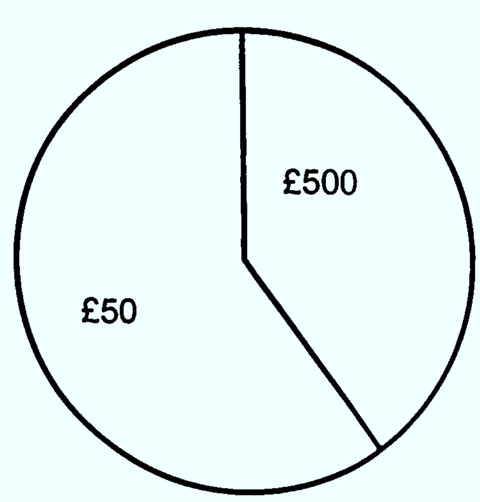

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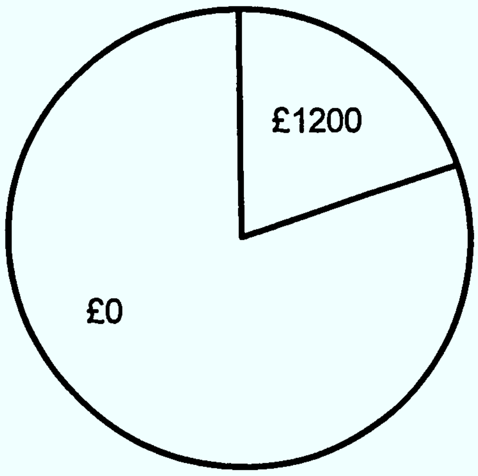

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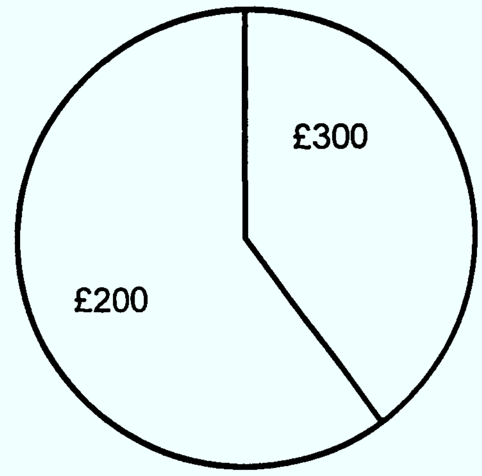

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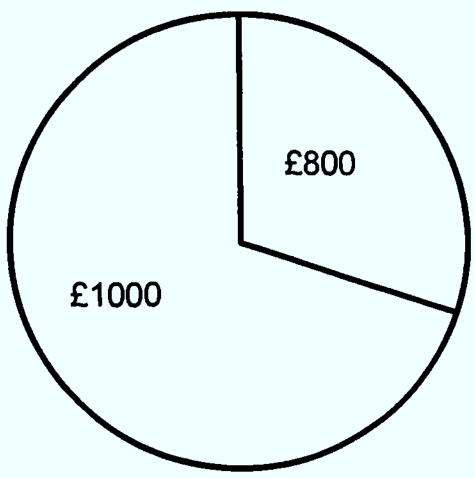

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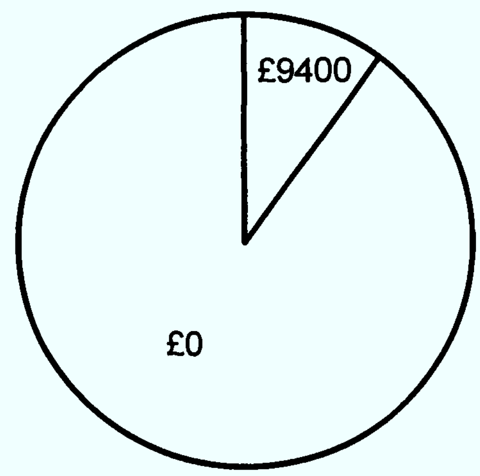

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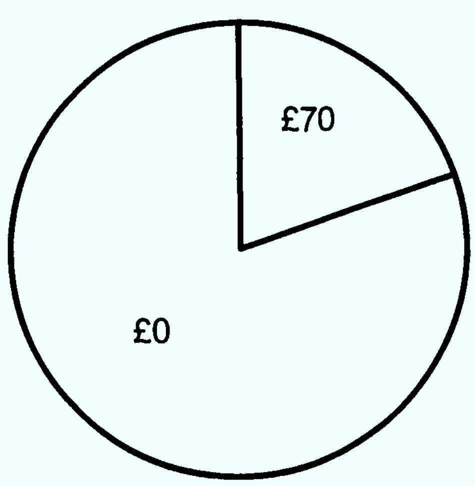

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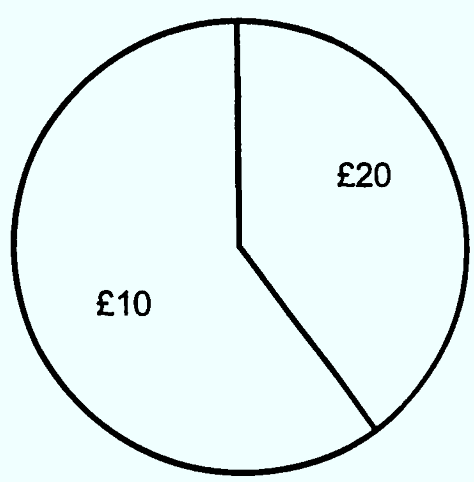

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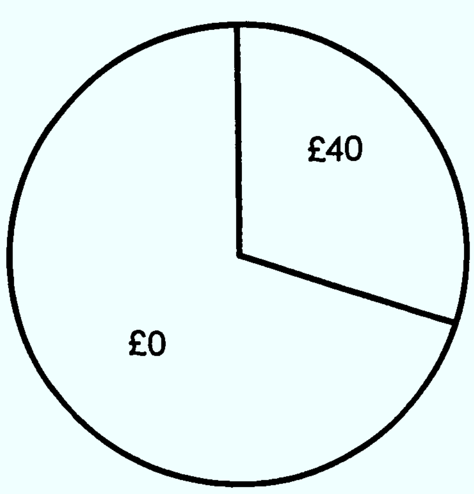

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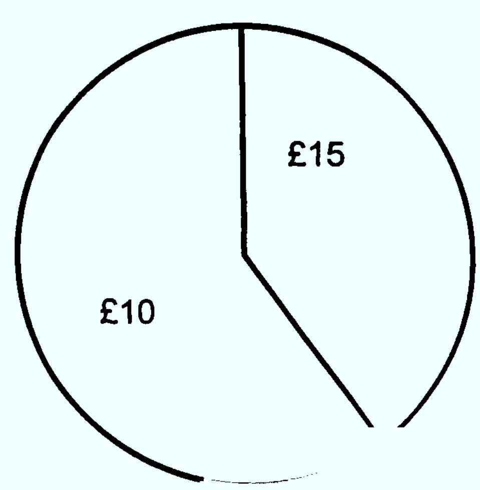

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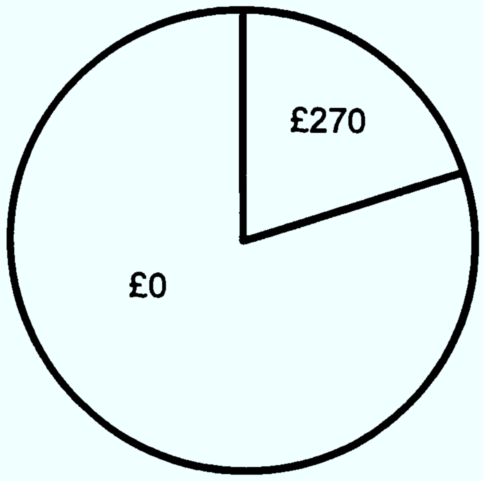

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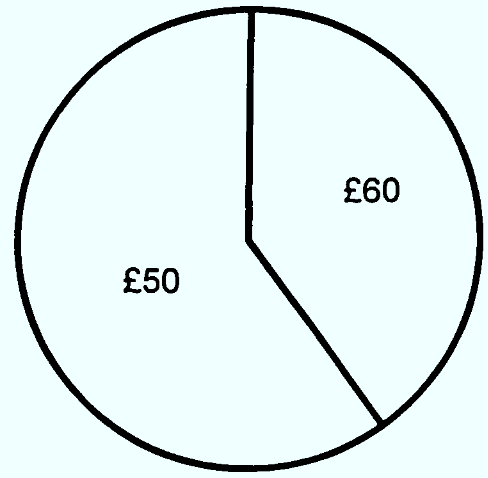

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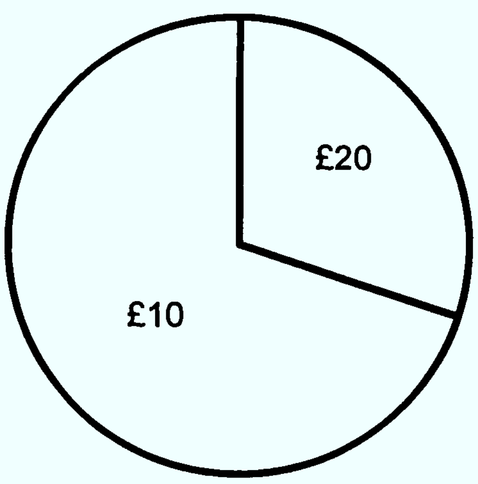

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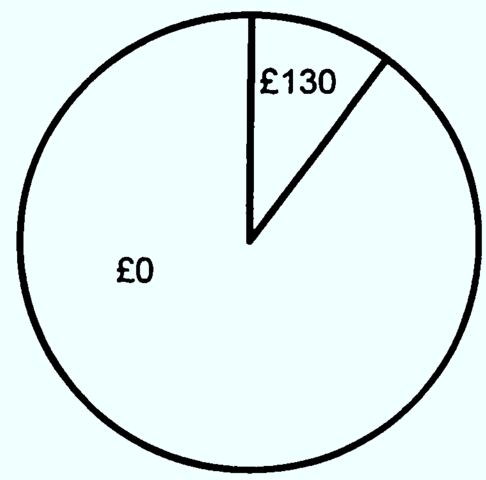

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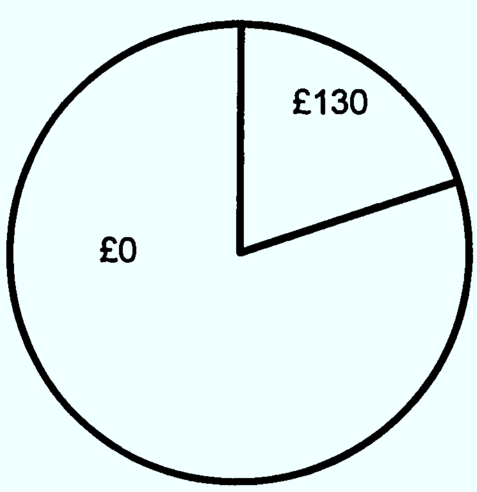

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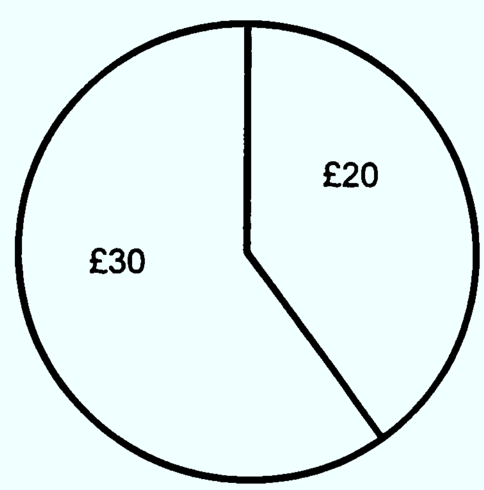

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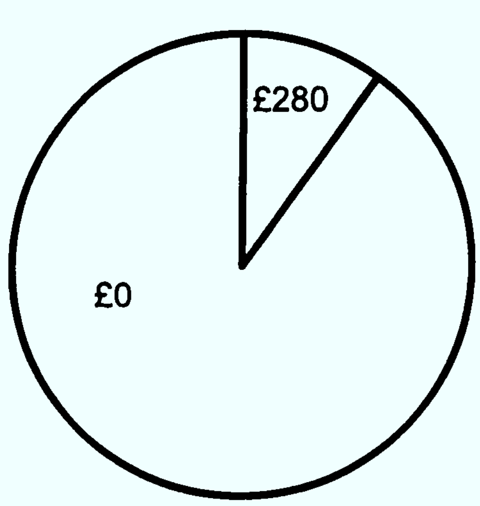

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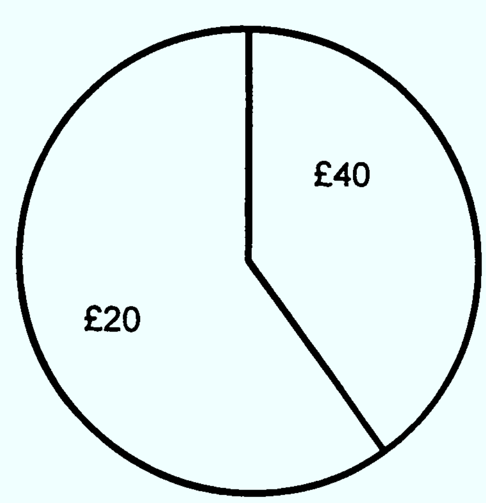


Appendix II

This test requires you to make choices between pairs of imaginary bets that are represented in a pie chart format (see below).

For each bet you should imagine there is a pointer in the centre of each circle. This imaginary pointer can be spun and you would win or lose whatever amount is written in the section the pointer lands on. To make this clearer there is a practice trial at the bottom of this page.

In this example if you choose Bet A there is a 70% chance that you would lose £50 (- £50) and a 30% chance that you would win £300. Alternatively if you choose Bet B there is an 80% chance that you would win £30 and a 20% chance that you would win £155.

On the following pages there are twenty more pairs of bets, all you have to do is choose which bet from each pair YOU would rather play. Please circle either A or B to indicate which bet is YOUR choice.

You will notice that for each pair of bets one choice offers a large chance of a loss and a small chance of a larger win, while the other choice either offers the possibility of a certain win or a large chance of winning nothing against the chance of a larger win.

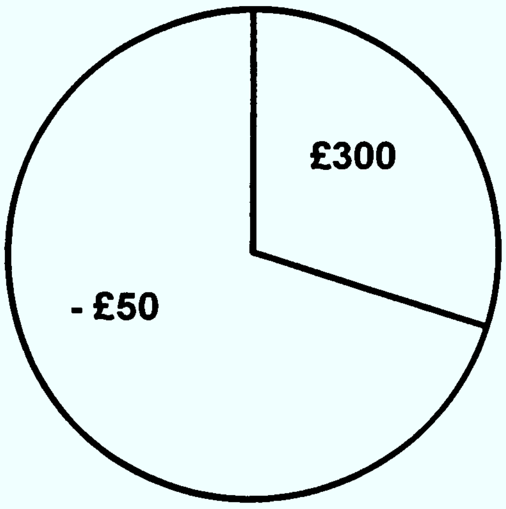
There are no right or wrong answers, we are only interested in your personal preference. Please try to answer as if you were making a choice between real bets.

Remember, for each pair of bets circle either A or B to indicate which you prefer.

Thank you.

Practice

A



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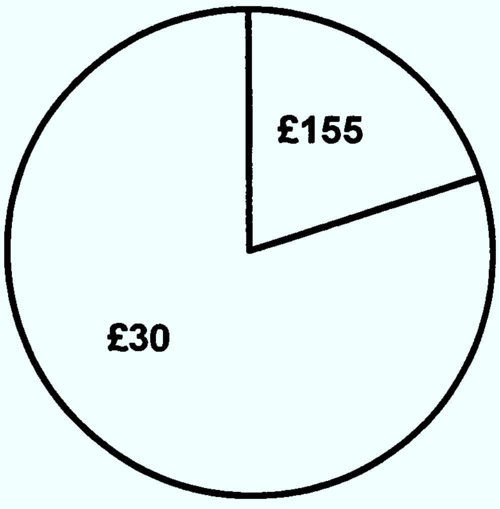

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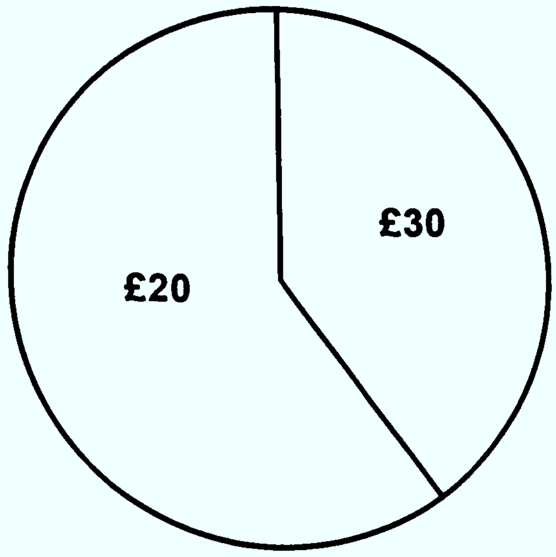

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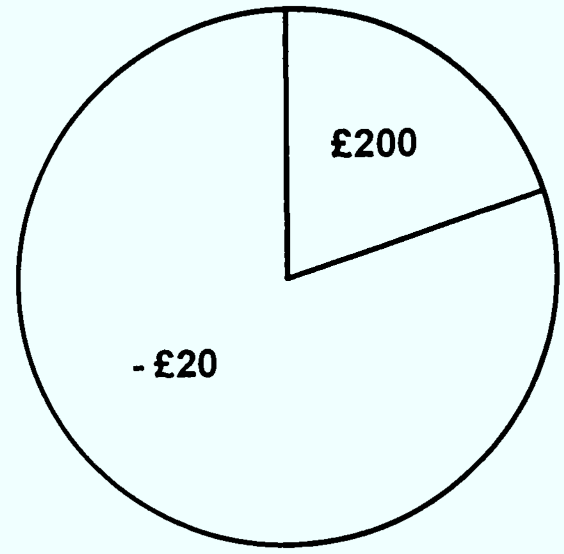

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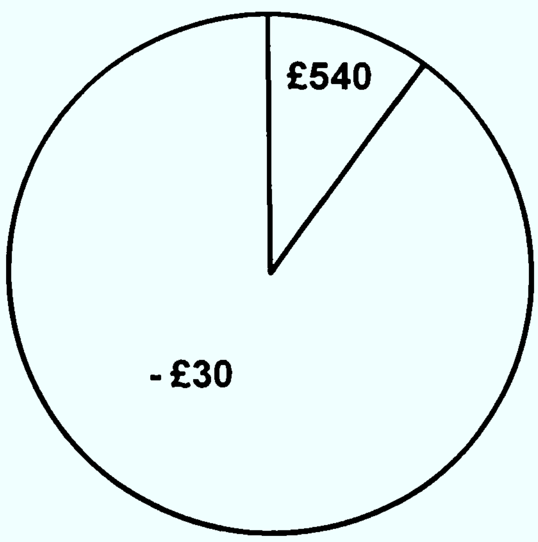

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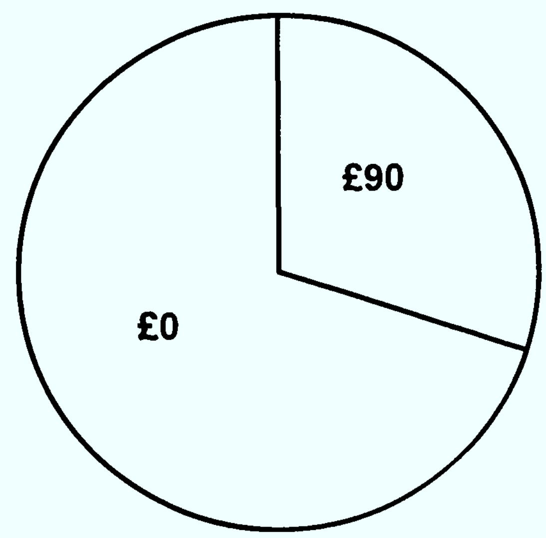

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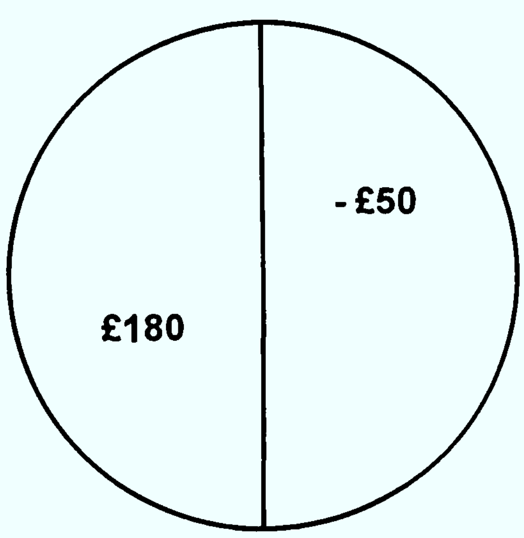

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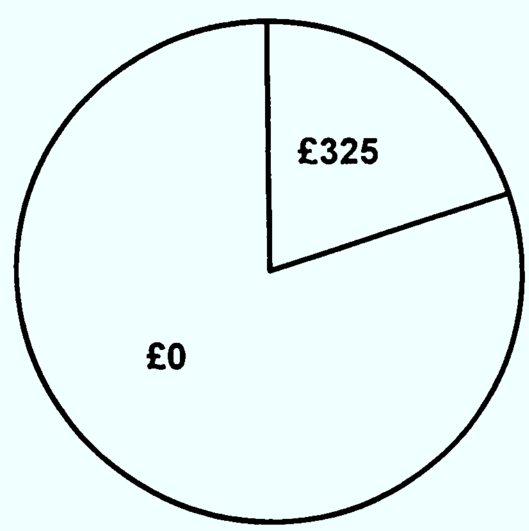

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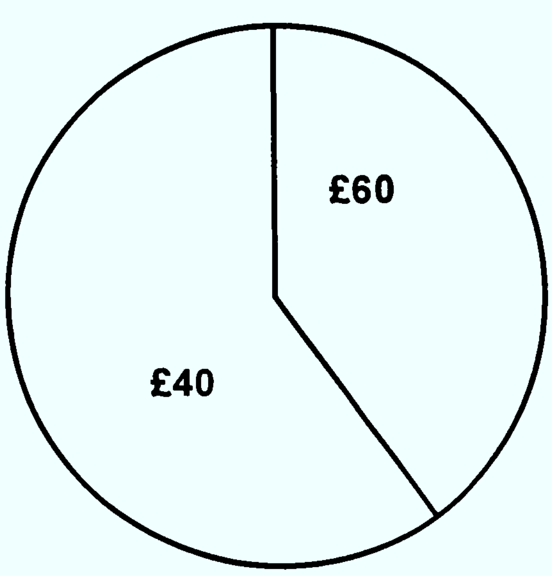

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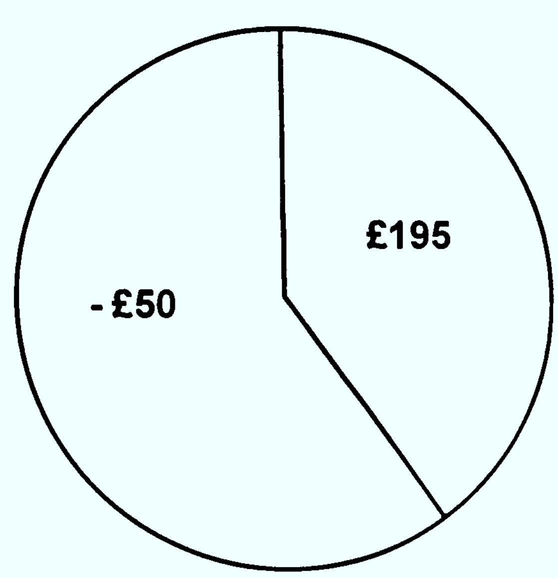

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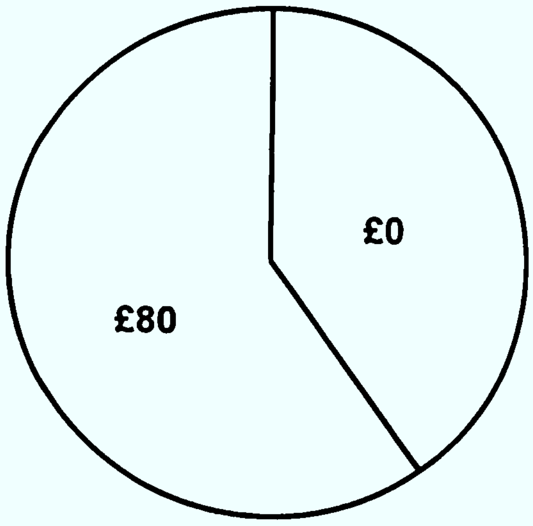

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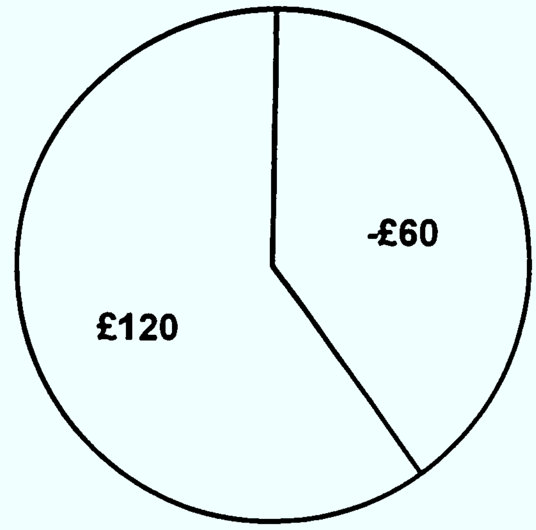

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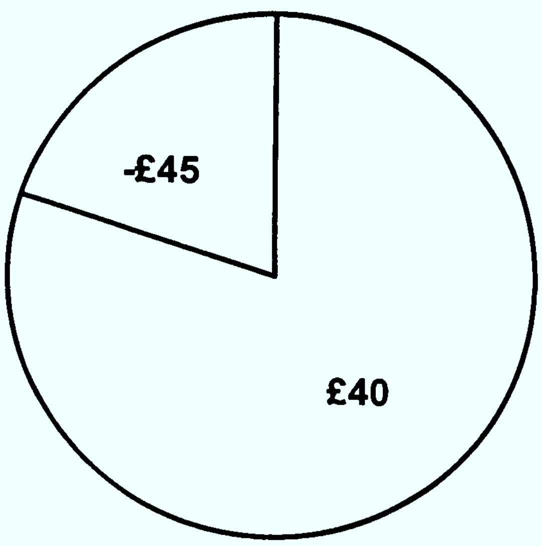

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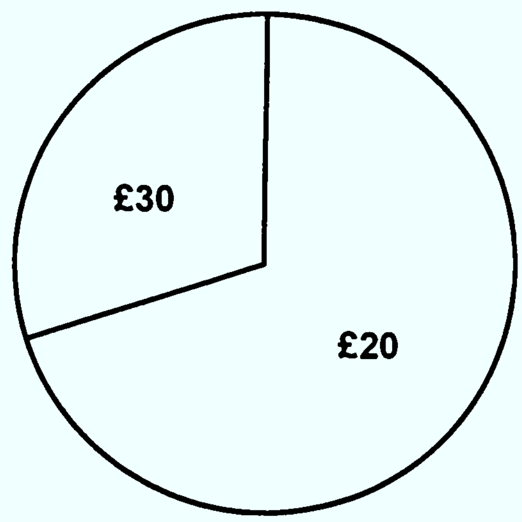

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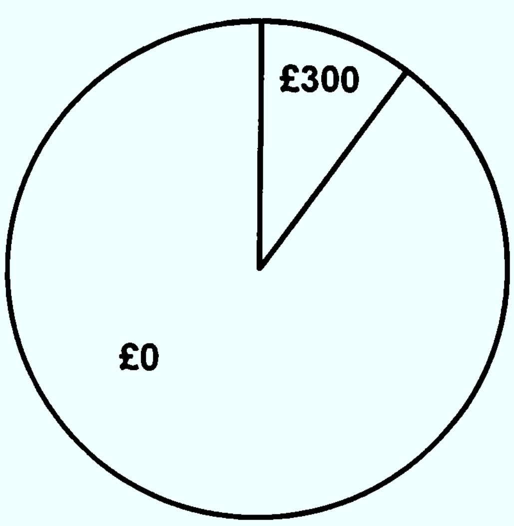

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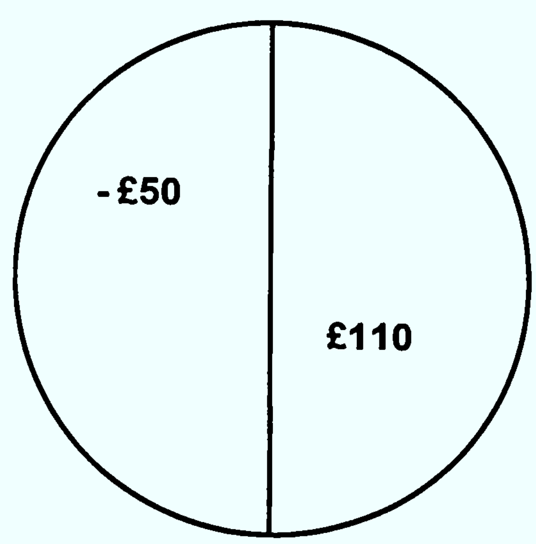

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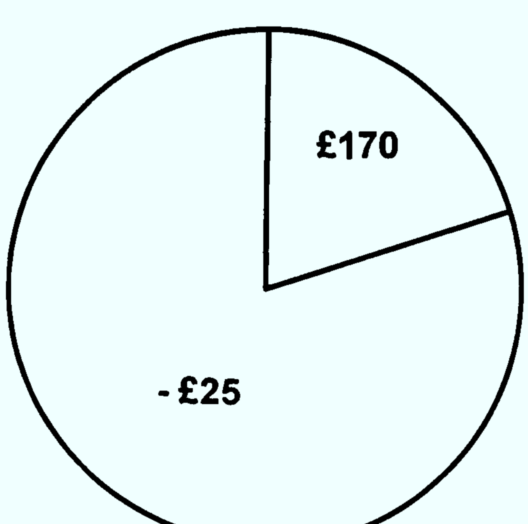

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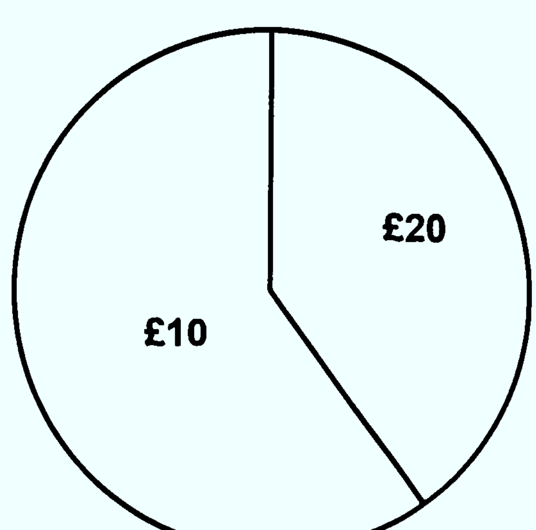

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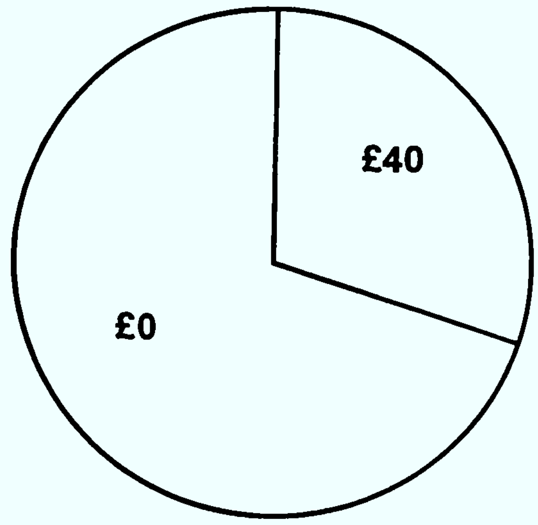

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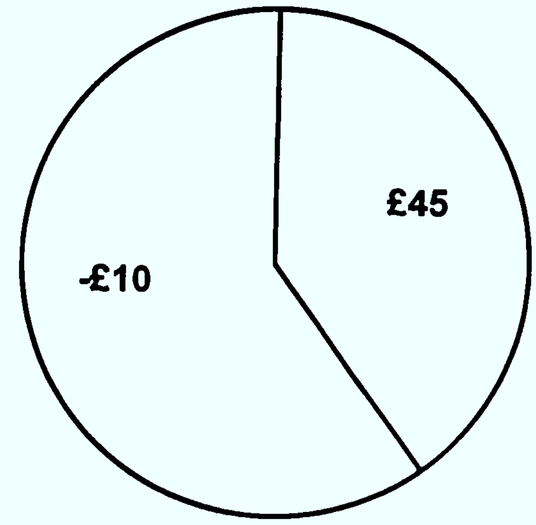

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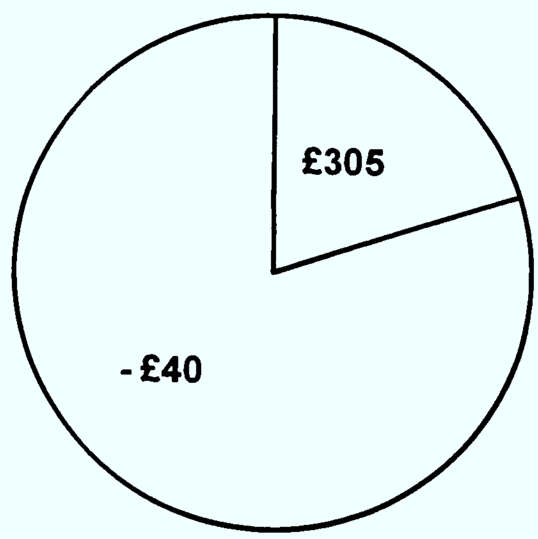

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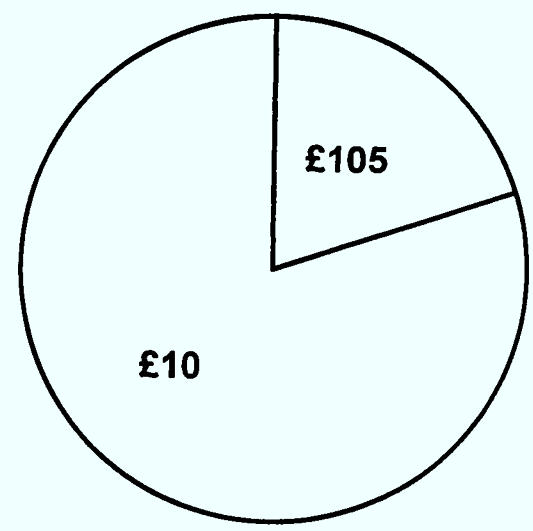

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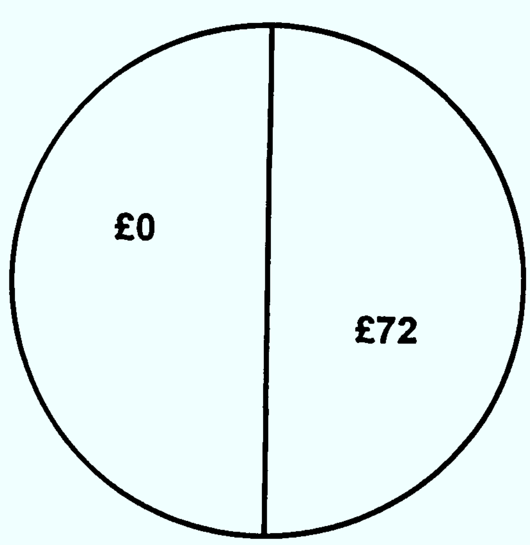

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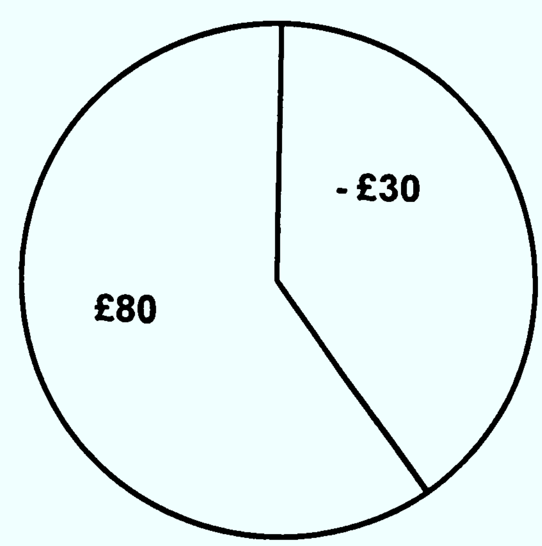

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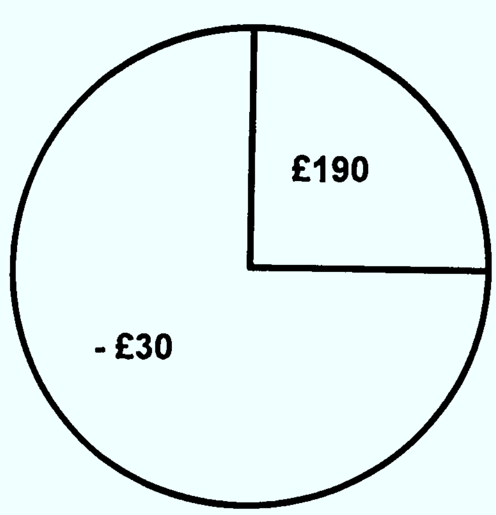

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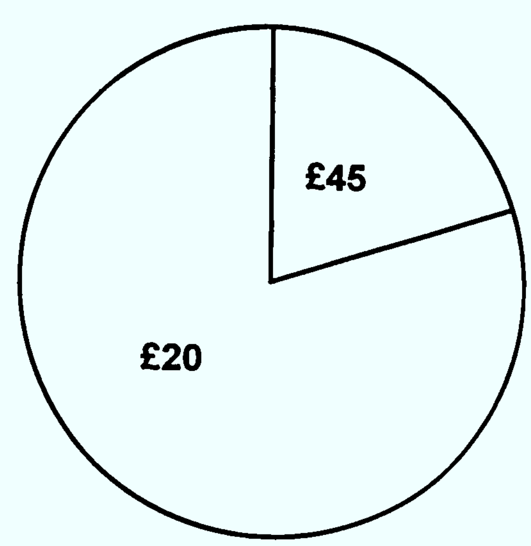
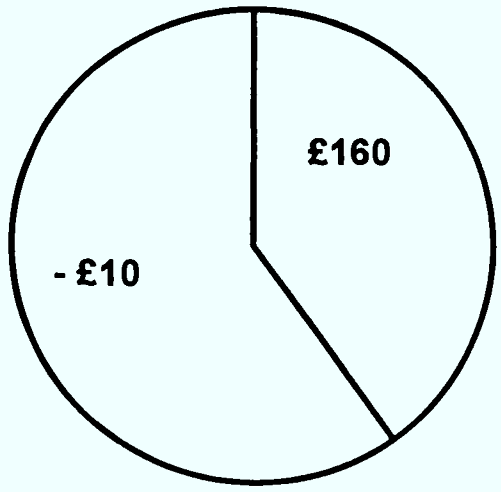


13.

A



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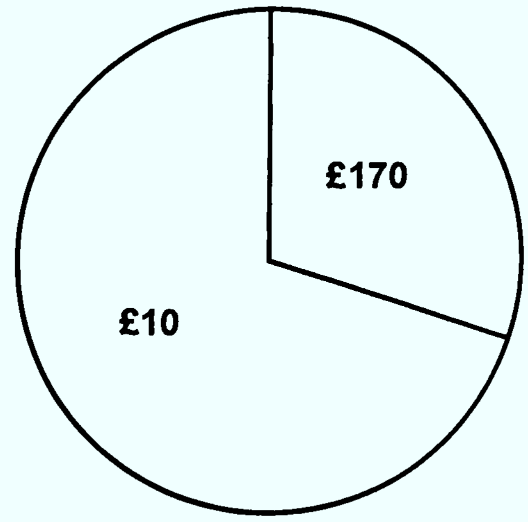

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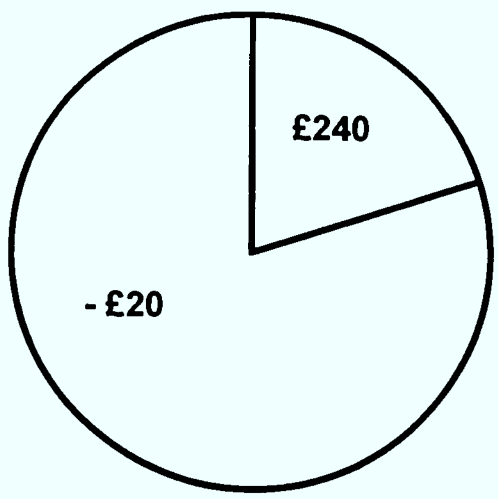

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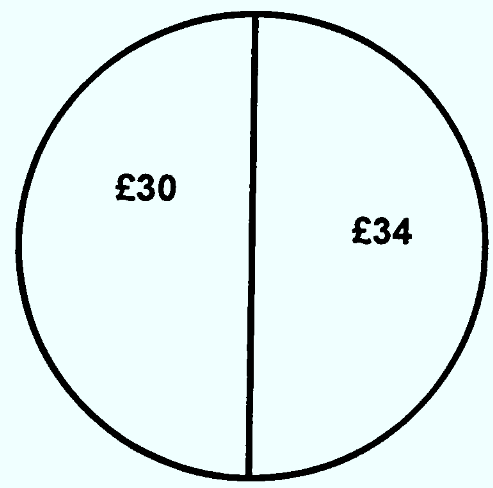

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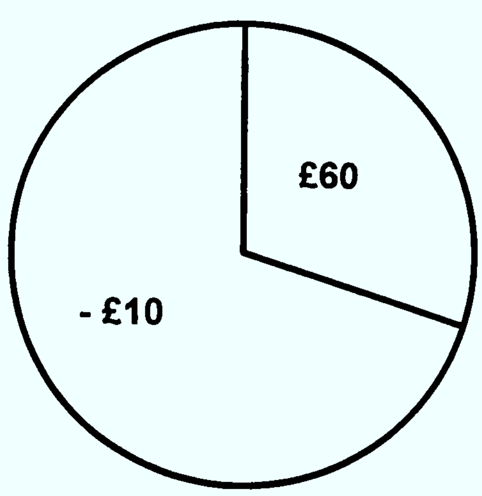

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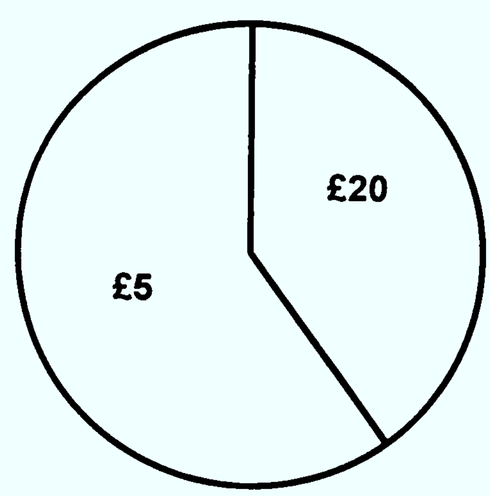

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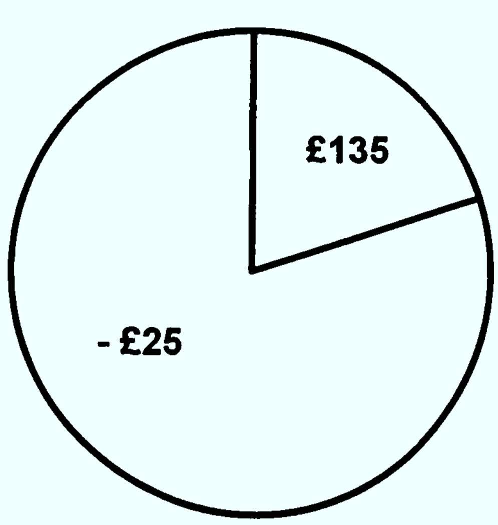

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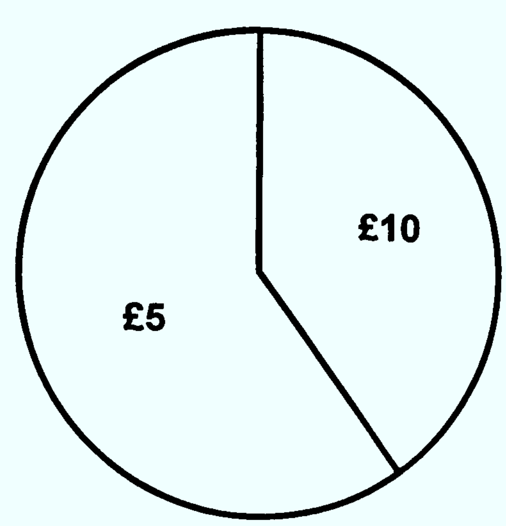

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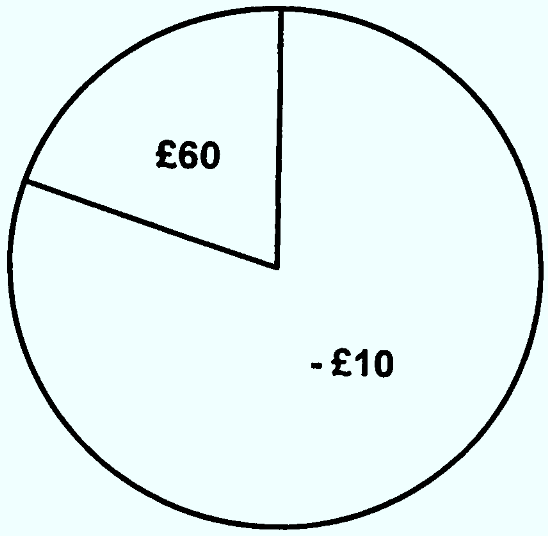

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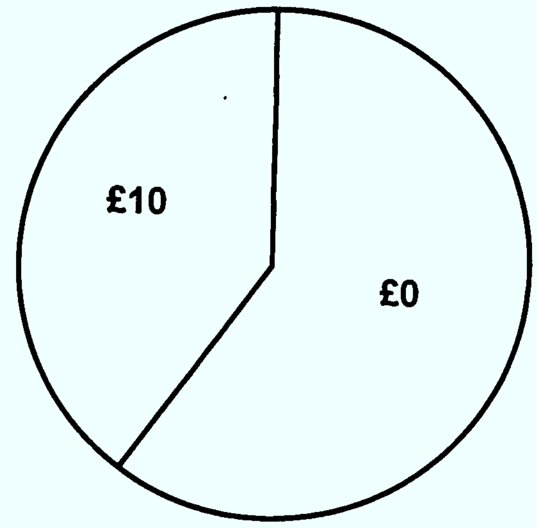

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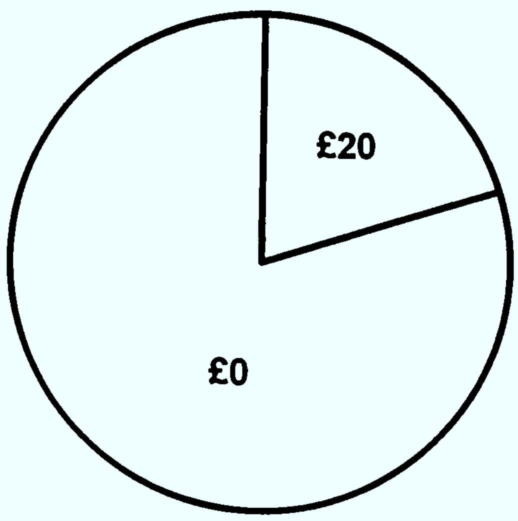

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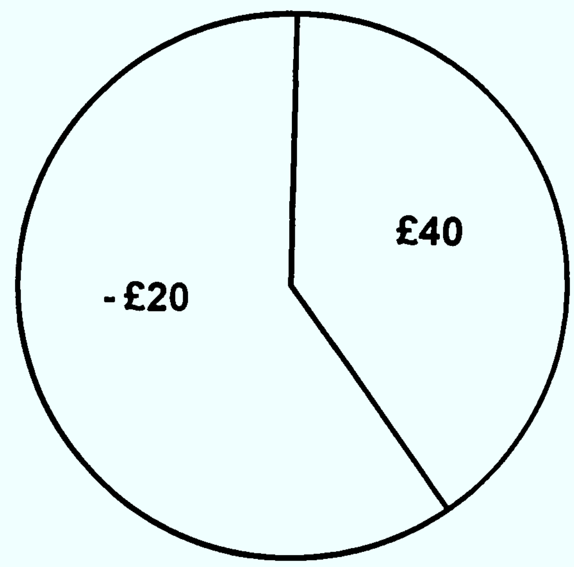

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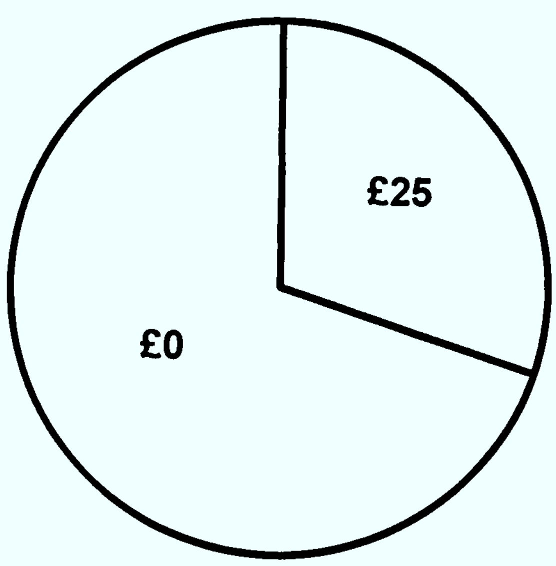

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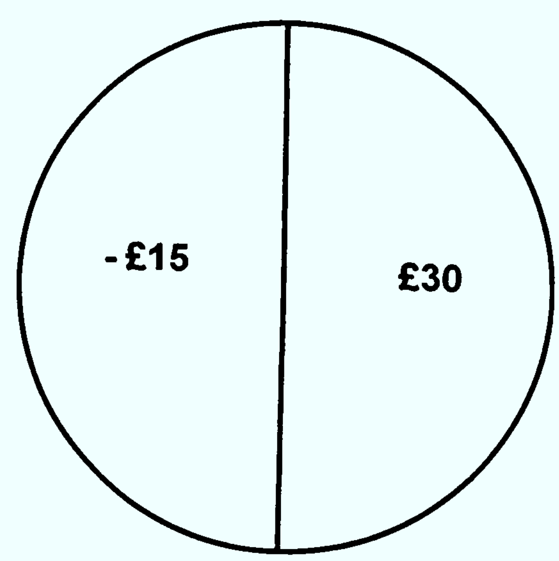

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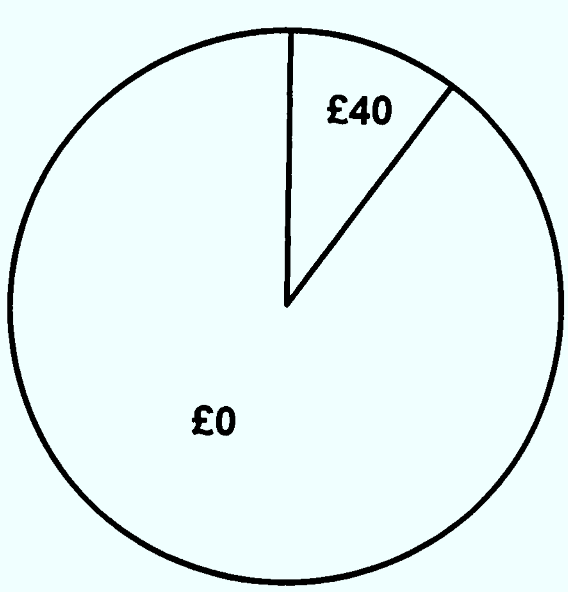

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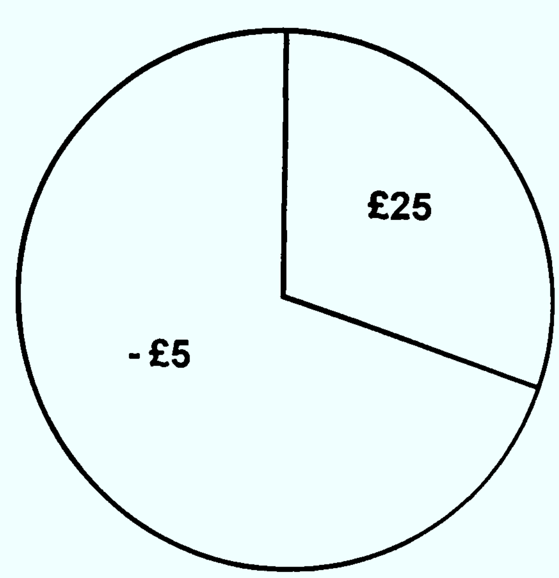

Appendix III

Listed below are various activities that people sometimes do that involve some degree of risk. Please rate the extent to which you would be likely to do each of these things. Although some of the items may not apply directly to your current situation, please reply as if they did. Please use the following scale and circle the number that corresponds to the extent to which you be likely to do these things.

1	2	3	4	5
I would never do this		I might do this		I would do definitely do this

1. Leave your car unlocked for several hours while picnicking in the country.	1	2	3	4	5
2. See a movie without knowing much about it.	1	2	3	4	5
3. Drive 20 miles over the speed limit on a major highway.	1	2	3	4	5
4. Go on a vacation without a specific itinerary.	1	2	3	4	5
5. Go to an aids clinic with a friend diagnosed HIV-positive.	1	2	3	4	5
6. Drink from a water fountain in a public park.	1	2	3	4	5
7. Make a recipe for the first time for guests.	1	2	3	4	5
8. Sit directly on a public toilet seat in a department store.	1	2	3	4	5
9. Go camping in a national park where there are grizzly bears.	1	2	3	4	5
10. Let a 2 year old play on the kitchen floor after broken glass had been swept up with a broom.	1	2	3	4	5
11. Drink from a cup used by a friend.	1	2	3	4	5
12. Leave your car unlocked for several hours while shopping at a mall.	1	2	3	4	5
13. Pet an unfamiliar large dog in the park when the owner is not in sight.	1	2	3	4	5
14. Use a toilet stall whose latch is broken.	1	2	3	4	5
15. Drive in sleet to do an errand you could postpone.	1	2	3	4	5
16. Go out without a coat in cool weather.	1	2	3	4	5
17. Not put the parking brake on when the car is on a slight hill, with the car in gear.	1	2	3	4	5
18. Swim less than 30 minutes after eating.	1	2	3	4	5
19. Allow a stranger to come into your home to use your phone.	1	2	3	4	5
20. Drive in a snowstorm to do an errand you could postpone.	1	2	3	4	5
21. Drive 10 miles over the speed limit on a major highway.	1	2	3	4	5
22. Borrow something from a friend without asking because he/she was unavailable.	1	2	3	4	5
23. Drink from a mountain stream.	1	2	3	4	5
24. Walk under a ladder.	1	2	3	4	5
25. Leave your house unlocked when you're home during the day.	1	2	3	4	5
26. Order a dish in a foreign restaurant when you don't know the ingredients.	1	2	3	4	5
27. Spray your kitchen with a pesticide to get rid of bugs.	1	2	3	4	5
28. Pick up a hitchhiker.	1	2	3	4	5
29. Leave the iron plugged in with the dial in the "off" position.	1	2	3	4	5
30. Drive somewhere without directions.	1	2	3	4	5
31. Drive in a thunderstorm to do an errand you could postpone.	1	2	3	4	5
32. Open a can of soup without wiping the top.	1	2	3	4	5

Appendix IV

Age.................. Sex M /F

Please answer each question by putting a circle around the 'YES' or the 'NO' following the questions. There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about the answers.

Please remember to answer each question

1. Would you enjoy water skiing?...	YES	NO
2. Do you sometimes get so restless that you cannot sit in a chair long?	YES	NO
3. Do you often long for excitement?..	YES	NO
4. Usually do you prefer to stick to sweets and foods you know, to trying new ones on the chance of finding something better?..........	YES	NO
5. Would you feel sorry for a lonely stranger in a group?................	YES	NO
6. Do you quite enjoy taking risks?...	YES	NO
7. Would you like to be a pop star?..	YES	NO
8. Do you often get very interested in your friend's problems?...........	YES	NO
9. Do you save regularly?..	YES	NO
10. Would you enjoy parachute jumping?.......................................	YES	NO
11. Do you think that people are too bothered about the feelings of animals?..	YES	NO
12. Do you often buy things on impulse?..	YES	NO
13. Would you prefer an exciting job involving travel and adventure to a more safe secure one?..	YES	NO
14. Do unhappy children who are sorry for themselves annoy you?......	YES	NO
15. Do you generally do and say things without stopping to think?........	YES	NO
16. Would you like to run an adventure playground?..........................	YES	NO
17. Do you feel sorry for shy children?...	YES	NO
18. Do you often get into a jam because you do things without thinking?	YES	NO
19. Would you enjoy gambling?..	YES	NO
20. Do you think it is silly for people to cry out of happiness?..............	YES	NO
21. Do you usually work quickly without bothering to check your answers?..	YES	NO
22. Do you like diving off the highboard?.......................................	YES	NO
23. Do people you are with have a strong influence on your moods?....	YES	NO
24. Are you an impulsive person?..	YES	NO
25. Do you enjoy new and exciting happenings and sensations, even if they are a little frightening and unusual?..................................	YES	NO
26. Does it affect you very much when one of your friends seems upset?..	YES	NO
27. Do you usually think carefully before doing anything?..................	YES	NO
28. Would you like to learn to fly an aeroplane?..............................	YES	NO
29. Do you ever get deeply involved with the feelings of a character in a film, play or novel?..	YES	NO
30. Do you often do things on the spur of the moment?.....................	YES	NO
31. When the odds are against you, do you still usually think it worth taking a chance?...	YES	NO
32. Do you get very upset when you see someone cry?.....................	YES	NO
33. Do you sometimes break rules on the spur of the moment?...........	YES	NO
34. Do you go very carefully when you are in unusual situations?.........	YES	NO
35. Does it make you laugh when you see others in your group laughing?..	YES	NO
36. Do you mostly speak before thinking things out?........................	YES	NO
37. At a fairground, would you prefer to play darts and see sideshows to going on the big dipper and the dodgem cars?......................	YES	NO

PLEASE TURN OVER

38. Do you get worried when others around you are worrying and panicking?..	YES	NO
39. Do you often get involved in things you later wish you could get out of?..	YES	NO
40. Do you quite like taking chances?......................................	YES	NO
41. When a friend starts talking about his or her problems, do you try to change the subject?...	YES	NO
42. Do you get so "carried away" by new and exciting ideas, that you never think of possible snags?......................................	YES	NO
43. Do you find it hard to understand people who risk their necks climbing mountains?..	YES	NO
44. Can you make decisions without worrying about other people's feelings?..	YES	NO
45. Do you get bored more easily than most people, doing the same old things?...	YES	NO
46. Would you like to travel to exciting places?............................	YES	NO
47. Can you understand why some people get upset so easily?........	YES	NO
48. Do you think that planning takes the fun out of things?..............	YES	NO
49. Do you sometimes like doing things that are a bit frightening?.....	YES	NO
50. Do you stay happy even though your friends are upset over something?...	YES	NO
51. Do you need to use a lot of self-control to keep out of trouble?....	YES	NO
52. Would life with no danger in it be too dull for you?....................	YES	NO
53. Do you feel more annoyed than sorry for someone who is crying?..	YES	NO
54. Would you be put off a job involving quite a bit of danger?.........	YES	NO
55. Do you prefer getting into a swimming pool slowly to diving straight in?...	YES	NO
56. Are you often surprised at people's reactions to what you do or say?..	YES	NO
57. Do you get very annoyed if someone keeps you waiting?..........	YES	NO
58. Would you enjoy the sensation of skiing very fast down a high mountain slope?...	YES	NO
59. Do you like watching people open presents?........................	YES	NO
60. Would you prefer an unexpected outing to one you have looked forward to for a while?..	YES	NO
61. Would you like to go scuba diving?......................................	YES	NO
62. Would you find it very hard to tell someone bad news?.............	YES	NO
63. Do you get very restless if you have to stay around home for any length of time?..	YES	NO
64. Do you prefer quiet holidays to exciting adventurous ones?.........	YES	NO
65. Can you imagine the sadness someone would feel if their pet suddenly died?...	YES	NO
66. Are you very keen on sport?..	YES	NO
67. When you watch a favourite TV program, can you feel with the hero or heroine, when they are sad, happy or angry?...............	YES	NO
68. Can you imagine what it must be like to be very lonely?.............	YES	NO
69. Would deep sea diving appeal to you?..................................	YES	NO
70. Do you think it is stupid to think animals have the same sort of feelings as we have?...	YES	NO
71. Do you sometimes put down the first answer that comes into your head, during a test and forget to check it later?.................	YES	NO
72. Do you find it hard to give advice to your friends when they ask for it?..	YES	NO
73. Would you like to go pot holing?..	YES	NO
74. Do you feel very sorry for children who get bullied a lot?...........	YES	NO
75. Would or do you enjoy going to discos?................................	YES	NO
76. Are you happy when you are with a cheerful group and sad when the others are glum?..	YES	NO

Appendix V

This is a questionnaire to assess cigarette use. Please fill in the details at the start.
This questionnaire is confidential and this information will not be given to anyone else.

Age:................................ Sex: (circle) Male Female

---

For each of the following questions please circle the option which applies to you.

1. Which of the following statements best describes your cigarette use?
   (a) Never Smoked
   (b) Tried Cigarettes once or twice
   (c) Ex-smoker
   (d) Current Smoker

If you circled option (a) please ignore the rest of the questionnaire, all other responders please answer all the following questions.

2. Which of the following best describes your average daily cigarette consumption?
   (a) Do not smoke each day
   (b) 1-5 per day
   (c) 6-10 per day
   (d) 11-20 per day
   (e) Other (please state)...

3. If you do not smoke daily how many cigarettes do you smoke in a week?
   Please write in the number. [ ]

4. If you do not smoke daily please indicate how frequently you do smoke cigarettes
   (a) On weekends
   (b) 1-2 days a week
   (c) 2-4 days a week
   (d) Other..

5. At what age did you start smoking?...

6. If you have stopped smoking, how old were you when you stopped?.............................

7. Why did you start smoking?
   (a) Cigarette advertising
   (b) Experimentation
   (c) Rebellion
   (d) Friends smoked
   (e) Image
   (f) Other (please state)..

8. Why do you smoke cigarettes? Please circle <u>all</u> that apply to you.
(a) Habit
(b) Friends smoke
(c) Enjoy the taste
(d) Enjoy the sensation from smoking
(e) Helps concentration
(f) Other (please state)...

Appendix VI

Age:………………… Sex: M / F

Please answer each question by putting a circle around the 'YES' or 'NO' following the question. There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about each question.

Please remember to answer each question

1. Would you enjoy water skiing?……………………………………	YES	NO
2. Usually do you prefer to stick to brands you know are reliable, to trying new ones on the chance of finding something better?…………………………………………………………	YES	NO
3. Would you feel sorry for a lonely stranger?……………………	YES	NO
4. Do you quite enjoy taking risks?………………………………	YES	NO
5. Do you often get emotionally involved with your friends' problems?………………………………………………………	YES	NO
6. Would you enjoy parachute jumping?…………………………	YES	NO
7. Do you often buy things on impulse?……………………………	YES	NO
8. Do unhappy people who are sorry for themselves irritate you?…	YES	NO
9. Do you generally do and say things without stopping to think?…	YES	NO
10. Are you inclined to get nervous when others around you seem to be nervous?……………………………………………………	YES	NO
11. Do you often get into a jam because you do things without thinking?………………………………………………………	YES	NO
12. Do you think hitch-hiking is too dangerous a way to travel?……	YES	NO
13. Do you find it silly for people to cry out of happiness?………	YES	NO
14. Do you like diving off the highboard?…………………………	YES	NO
15. Do people you are with have a strong influence on your moods?.	YES	NO
16. Are you an impulsive person?…………………………………	YES	NO
17. Do you welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional……….	YES	NO
18. Does it affect you very much when one of your friends seems upset?……………………………………………………………	YES	NO
19. Do you usually think carefully before doing anything?…………	YES	NO
20. Would you like to learn to fly an aeroplane?……………………	YES	NO
21. Do you ever get deeply involved with the feelings of a character in a film, play or novel?…………………………………………	YES	NO
22. Do you often do things on the spur of the moment?……………	YES	NO
23. Do you get very upset when you see someone cry?……………	YES	NO
24. Do you sometimes find someone else's laughter catching?……..	YES	NO
25. Do you mostly speak without thinking things out?…………….	YES	NO
26. Do you often get involved in things you later wish you could get out off?…………………………………………………………	YES	NO

Please turn over

27. Do you get so 'carried away' by new and exciting ideas, that you never think of possible snags?.......................................	YES	NO
28. Do you find it hard to understand people who risk their necks climbing mountains?..	YES	NO
29. Can you make decisions without worrying about people's feelings?..	YES	NO
30. Do you sometimes like doing things that are a bit frightening?...	YES	NO
31. Do you need to use a lot of self-control to keep out of trouble?...	YES	NO
32. Do you become more irritated than sympathetic when you see someone cry?..	YES	NO
33. Would you agree that almost everything enjoyable is illegal or immoral?..	YES	NO
34. Generally do you prefer to enter cold sea water gradually, to diving or jumping straight in?.......................................	YES	NO
35. Are you often surprised at people's reactions to what you do or say?..	YES	NO
36. Would you enjoy the sensation of skiing very fast down a high mountain slope?......	YES	NO
37. Do you like watching people open presents?.......................	YES	NO
38. Do you think an evening out is more successful if it is unplanned or arranged at the last moment?.........................	YES	NO
39. Would you like to go scuba diving?................................	YES	NO
40. Would you find it very hard to break bad news to someone?.....	YES	NO
41. Would you enjoy fast driving?.......................................	YES	NO
42. Do you usually work quickly, without bothering to check?.......	YES	NO
43. Do you often change your interests?................................	YES	NO
44. Before making up your mind, do you consider all the advantages and disadvantages?.......................................	YES	NO
45. Can you get very interested in your friends' problems?...........	YES	NO
46. Would you like to go pot-holing?...	YES	NO
47. Would you be put off a job involving quite a bit of danger?......	YES	NO
48. Do you prefer to 'sleep on it' before making decisions?..........	YES	NO
49. When people shout at you, do you shout back?.....................	YES	NO
50. Do you feel sorry for very shy people?.............................	YES	NO
51. Are you happy when you are with a cheerful group and sad when the others are glum?..	YES	NO
52. Do you usually make up your mind quickly?......................	YES	NO
53. Can you imagine what it must be like to be very lonely?.........	YES	NO
54. Does it worry you when others are worrying and panicky?........	YES	NO
<u>PLEASE CHECK THAT YOU HAVE ANSWERED ALL THE QUESTIONS</u>		

Appendix VII

Read each statement carefully, but don't spend too much time deciding on the answer. Please answer every statement. Remember there are no or right answers - just describe your own personal opinions and feelings.

Please Circle True (T) or False (F)	T	F
1. I usually am confident that everything will go well, even in situations that worry most people…………	T	F
2. I often try new things just for fun or thrills, even if most people think it is a waste of time…………	T	F
3. I like to discuss my experiences and feelings openly with friends instead of keeping them to myself…………	T	F
4. When nothing new is happening I usually start looking for something that is thrilling or exciting…………	T	F
5. Usually I am more worried than most people that something might go wrong in the future…………	T	F
6. I nearly always stay relaxed and carefree, even when nearly everyone else is fearful…………	T	F
7. My friends find it very hard to know my feelings because I seldom tell them about my private thoughts…………	T	F
8. I often stop what I am doing because I get worried, even when my friends tell me everything will go well…………	T	F
9. I usually do things my own way - rather than giving into the wishes of other people…………	T	F
10. I usually feel tense and worried when I have to do something new and unfamiliar…………	T	F
11. I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about…………	T	F
12. I often do things based on how I feel at the moment without thinking about how they were done in the past…………	T	F
13. I often feel tense and worried in unfamiliar situations, even when others feel there is no danger at all…………	T	F
14. I often break rules and regulations when I think I can get away with it………	T	F
15. I don't care very much whether other people like me or the way I do things…	T	F
16. I usually stay calm and secure in situations that most people would find physically dangerous…………	T	F
17. People find it easy to come to me for help, sympathy, and warm understanding…………	T	F
18. I am much more reserved and controlled than most people…………	T	F
19. When I have to meet a group of strangers, I am more shy than most people…..	T	F
20. I am strongly moved by sentimental appeals (like when asked to help crippled children)…………	T	F
21. I have a reputation as someone who is very practical and does not act on Emotion…………	T	F
22. I often avoid meeting strangers because I lack confidence with people I do not know…………	T	F
23. I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly…………	T	F
Please Turn Over		

24. I usually push myself harder than most people do because I want to do as well as I possibly can..........	T	F
25. I am slower than most people to get excited about new ideas and activities....	T	F
26. I often push myself to the point of exhaustion or try to do more than I really can..........	T	F
27. I would probably stay relaxed and outgoing when meeting a group of strangers, even if I were told they were unfriendly..........	T	F
28. I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by..........	T	F
29. I like to think about things for a long time before I make a decision..........	T	F
30. I often follow my instincts, hunches, or intuition without thinking through all the details..........	T	F
31. I am satisfied with my accomplishments, and have little desire to do better......	T	F
32. I have less energy and get tired more quickly than most people..........	T	F
33. I usually think about all the facts in detail before I make a decision..........	T	F
34. I <u>nearly always</u> think about all the facts in detail before I make a decision.......	T	F
35. I don't go out of my way to please other people..........	T	F
36. I can usually do a good job at stretching the truth to tell a funnier story or to play a joke on someone..........	T	F
37. I usually can stay "on the go" all day without having to push myself..........	T	F
38. I have trouble telling a lie, even when it is meant to spare someone else's feelings..........	T	F
39. I am better at saving money than most people..........	T	F
40. I often spend money until I run out of cash or get into debt from using too much credit..........	T	F
41. Because I so often spend too much money on impulse, it is hard for me to save money - even for special plans like a holiday..........	T	F
42. It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried..........	T	F
43. I usually feel much more confident and energetic than most people, even after minor illnesses or stress..........	T	F
44. I hate to make decisions based only on my first impressions..........	T	F
45. I am often moved by a fine speech or poetry..........	T	F
46. If I am embarrassed or humiliated, I get over it very quickly..........	T	F
47. I like to keep my problems to myself..........	T	F
48. I enjoy saving money more than spending it on entertainment or thrills..........	T	F
49. Even when I'm with friends, I prefer not to "open up" very much..........	T	F
50. I feel very confident and sure of myself in almost all social situations..........	T	F
51. I usually like to stay cool and detached from other people..........	T	F
52. I like to please other people as much as I can..........	T	F
53. I like to stay at home better than to travel or explore new places..........	T	F
54. I am usually so determined that I continue to work long after other people have given up..........	T	F

Appendix VIII

EAT-26

Age:______________ Sex:____________ Marital Status______________

Occupation:____

Father's Occupation:____

Mother's Occupation:____

Weight:__________________________ Height:_________________________

Please respond to each of the following questions.

1. Have you gone on eating binges where you feel that you may not be able to stop? (Eating much more than most people would eat under the circumstances)

No ☐ Yes ☐

If yes, on average, how many times per month in the last 6 months? _____________

2. Have you ever made yourself sick (vomited) to control your weight or shape?

No ☐ Yes ☐

If yes, on average, how many times per month in the last 6 months? _____________

3. Have you ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?

No ☐ Yes ☐

If yes, on average, how many times per month in the last 6 months? _____________

4. Have you ever been treated for an eating disorder?

No ☐ Yes ☐ If yes when? ____________________

5. Have you recently thought of or attempted suicide?

No ☐ Yes ☐ If yes, when?____________________

Please Turn Over

Please place a ✓ under the column which applies best to each of the numbered statements. Please answer each question carefully. Thank you.

	Always	Usually	Often	Some-times	Rarely	Never
1. Am terrified about being overweight						
2. Avoid eating when I am hungry						
3. Find myself preoccupied with food						
4. Have gone on eating binges where I feel I may not be able to stop						
5. Cut my food into small pieces						
6. Aware of the calorie content of foods I eat						
7. Particularly avoid food with a high Carbohydrate content (eg. bread, rice, potatoes etc)						
8. Feel that others would prefer if I ate more						
9. Vomit after I have eaten						
10. Feel extremely guilty after eating						
11. Am preoccupied with a desire to be thinner						
12. Think about burning up calories when I exercise						
13. Other people think I'm too thin						
14. Am preoccupied with the thought of having fat on my body						
15. Take longer than others to eat my meals						
16. Avoid foods with sugar in them						
17. Eat diet foods						
18. Feel that food controls my life						
19. Display self-control around food						
20. Feel that others pressure me to eat						
21. Give too much time and thought to food						
22. Feel uncomfortable after eating sweets						
23. Engage in dieting behaviour						
24. Like my stomach to be empty						
25. Have the impulse to vomit after meals						
26. Enjoy trying new rich foods						

Appendix IX

BITE

Instructions: Please complete the questionnaire, by circling either YES or NO, based on your feelings and behaviour over the past three months.

1. Do you have a regular daily eating pattern? YES NO

2. Are you a strict dieter? YES NO

3. Do you feel a failure if you break your diet once? YES NO

4. Do you count the calories of everything you eat, Even when not on a diet? YES NO

5. Do you ever fast for a whole day? YES NO

6. .....If yes how often is this? (circle number)

   Every second day 5 2-3 times a week 4
   Once a week 3 Now and then 2 Have once 1

7. Do you do any of the following to help you lose weight? (circle number)

	Never	Occasionally	Once a week	2-2 times a week	Daily	2-3 times a day	5+ times a day
Take diet pills	0	2	3	4	5	6	7
Take diuretics	0	2	3	4	5	6	7
Take laxatives	0	2	3	4	5	6	7
Make yourself vomit	0	2	3	4	5	6	7

8. Does your pattern of eating severely disrupt your life? YES NO

9. Would you say that food dominated your life? YES NO

10. Do you ever eat and eat until you are stopped by physical discomfort? YES NO

11. Are there times when all you can think about is food? YES NO

12. Do you eat sensibly in front of others and make up in private? YES NO

13. Can you always stop eating when you want to? YES NO

14. Do you ever experience *overpowering* urges to eat and eat and eat? YES NO

15. When you are feeling anxious do you tend to eat a lot? YES NO

16. Does the thought of becoming fat *terrify* you? YES NO

17. Do you ever eat large amounts of food rapidly (not a meal)? YES NO

18. Are you ashamed of your eating habits? YES NO

19. Do you worry that you have no control over much you eat? YES NO

20. Do you turn to food for comfort? YES NO

21. Are you able to leave food on the plate at the end of a meal? YES NO

22. Do you deceive people about how you eat? YES NO

23. Does how hungry you feel determine how much you eat? YES NO

24. Do you ever binge on large amounts of food? YES NO

25. ....If yes, do such binges leave you feeling miserable? YES NO

26. If you do binge, is this only when you are alone? YES NO

27. If you do binge, how often is this? (circle number)

Hardly ever	1	0nce a month	2
Once a week	3	2-3 times a week	4
Daily	5	2-3 time a day	6

28. Would you go to great lengths to satisfy an urge to binge? YES NO

29. If you overeat do you feel *very* guilty? YES NO

30. Do you ever eat in secret? YES NO

31. Are your eating habits what you would consider to be normal? YES NO

32. Would you consider yourself to be a compulsive eater? YES NO

33. Does your weight fluctuate by more than 5 pounds in a week? YES NO

Appendix X

BDI

On this questionnaire are groups of statements. Please read each group of statements carefully. Then pick out the one statement in each group which best describes the way you have been feeling the PAST WEEK INCLUDING TODAY! Circle the number beside the statement you picked. If several statements in the group seem to apply equally well, circle each one. Be sure to read all the statements in each group before making your choice.

1 0 I do not feel sad.
1 I feel sad.
2 I am sad all of the time and I can't snap out of it.
3 I am so sad or unhappy that I can't stand it.

2 0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel that the future is hopeless and that things cannot improve.

3 0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

4 0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

5 0 I don't feel particularly guilty.
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6 0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7 0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8 0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9 0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10 0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11 0 I am no more irritated now than I ever am.
1 I get annoyed or irritated more easily than I used to.
2 I feel irritated all the time now.
3 I don't get irritated at all by the things that used to irritate me.

12 0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13 0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions that before.
3 I can't make decisions at all anymore.

14 0 I don't feel I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel that there are permanent changes in my appearance that make me look unattractive.
3 I believe that I look ugly.

15 0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16 0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17 0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18 0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19 0 I haven't lost much weight, if any, lately.
1 I have lost more than 5 pounds.
2 I have lost more than 10 pounds.
3 I have lost more than 15 pounds.

I am purposely trying to lose weight by eating less. Yes_______ No________

20 0 I am no more worried abut my health than usual.
1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation.
2 I am very worried about physical problems and it's hard to think of much else.
3 I am so worried about my physical problems that I cannot think about anything else

21 0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

Appendix XI

Please answer the following questions by ticking the appropriate boxes or writing in the answers as necessary.

1. Sex ☐ Male ☐ Female

2. Age (please state in years)..

3. Have you ever used any of the following drugs?

☐ YES ☐ NO

If yes indicate which ones. If no please ignore the rest of the questionnaire.

☐ Amphetamine

☐ Ecstasy

☐ LSD (acid)

☐ Cocaine

☐ Heroin

☐ Cannabis

☐ Other (Please State)

Please turn over

4. If you have used ecstasy, how many times have you used it?

☐ Less than 10 times

☐ Between 11 and 20 times

☐ More than 20 times

5. When did you last use ecstasy? Please enter in days, weeks or months. ....

6. When did you last use drugs <u>other</u> than ecstasy? ....

7. What were the other drugs that you used?...

8. How many ecstasy do you typically take at one time?

☐ Less than one

☐ One

☐ More than one

9. What is the most ecstasy that you have taken at any one time? (please state) ....