



Marijuana Craving: a study of cue-reactivity

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ABSTRACT

Cue reactivity theory implies that in relation to drug use, exposure to drug related cues will produce an increased sense of craving for the substance. This study aimed to investigate the effects of exposure to marijuana related cues on marijuana users self reported levels of craving. 59 participants were involved in an online questionnaire containing the Marijuana Craving Questionnaire, the Leeds Dependence Questionnaire and the Becks Depression Inventory. Participants were split in to two groups: group one; no cues (n = 27; 15 males & 12 females) and group two (n= 32; 22 males & 10 females) who were exposed to marijuana related cues during completion of the Marijuana Craving Questionnaire. A one way MANCOVA was conducted, with participant's levels of dependence as a covariate. Although the levels of craving across the four factors of the Marijuana Craving Questionnaire (compulsivity, emotionality, expectancy and purposefulness) were slightly higher for group two than for group one the research concluded that there was no statistically significant difference between the self report levels of craving of the two groups; therefore rejecting its hypothesis.

KEY WORDS:	MARIJUANA CRAVING QUESTIONNAIRE (MCQ)	CUE REACTIVITY	CRAVING	CANNABIS	DRUG CRAVING
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Introduction and Literature Review.

“While drugs are a ‘taboo’ in societies which fear the artificial inducement of irrationality; It is for this reason that, ironically, they are increasingly popular as a part of everyday life: a chemical carnival, providing a temporary and reversible slackening of the bonds of reason” (Van Ree, 1997, as cited by South, 1999, pg.3)

Marijuana (also known as cannabis) use may be argued as having become somewhat normalised within British society (Hammersley & Leon, 2006) and is an increasingly common and well publicised practice. Frequent reference is made towards the drug within popular culture, with use being seemingly glorified by celebrities. Derbyshire (2008) reviewed how references to drug use within music lyrics has increased and has moved from condemning drug use to glorifying use of substances such as marijuana. Even Prince Harry admitted use of marijuana during his teenage years (BBC News online, 2002) as well as politicians, such as Barack Obama and Sarah Palin, publicising their earlier exploits with the substance (Campbell, 2008). Additionally, marijuana related paraphernalia is openly advertised and widely available. Although, the Alternative Trade Association (2008) does state that “the use of the hemp leaf symbol on any advertising, external window hoardings or external sign hoardings, is discouraged” the use of such a symbol in advertising is not illegal, nor is it illegal to supply marijuana related paraphernalia unless the sales person knows that paraphernalia will be used for illicit purposes (ATA, 2008). In a review conducted for the House of Commons, Sleator & Allen (2000) referred to marijuana as the “most widely cultivated, trafficked and used illicit drug in the United Kingdom” (Pg. 1). Owen (2007) highlighted that in 2006 approximately 22,000 people were treated for marijuana related problems in Britain and that the marijuana available has been found to be 25% stronger than that available during the 1990s. In 2002, research concluded that the financial costs of policing marijuana as a class B drug, as well as the sentencing costs, equates to approximately £50 million, which is enough to fund 500 full time police officers (May et al, 2002). The Independent Drugs Monitoring Unit (IDMU) has indicated that the market value of the marijuana

trade is within the region of £5 billion per year (Neligan, 2002). What's more, on top of these statistics, Hardwick & King (2008) in a review conducted on behalf of the Home Office concerning the potency of marijuana available on the streets, found that marijuana was no longer mainly an imported substance and that 97% of the herbal strains of the substance analysed were grown in the UK.

With regard to the prevalence of marijuana use, the British Crime Survey revealed that marijuana/cannabis was the most commonly used illicit drug amongst those aged 16-59 years, with 11% admitting use within the past twelve months; equalling approximately three million users (Condon & Smith, 2003). Statistics have also pointed out that the UK has the highest number of adolescent marijuana users in Europe, with two in five 15 year olds reporting having tried marijuana (BBC News online, 2004), as well as this Britain spends the highest amount of money on treating drug addicts in comparison with the rest of Europe (Dougherty, 2003). In reference to such widespread use of the substance Barton (2003) stated that "cannabis use is the most prevalent...leading to a situation where it is not seen as a problem in the way in which drugs such as heroin and cocaine are" (Pg. 43). In light of its increasing use, and with the mention of the dangers of heavy marijuana use, the 26th January 2009, saw an amendment to the Misuse of Drugs Act (1971) reclassifying cannabis and all cannaboid derivatives back up to a B class substance (Home Office, 2009). This is in opposition to current American decisions concerning marijuana, in which marijuana for medical use, such as chemotherapy induced nausea and glaucoma, is now legal in 13 states (Sullivan, 2009).

The decision in Britain to upgrade its classification caused quite a stir, especially as marijuana dependence and marijuana withdrawal are not recognised as clinically significant in the DSM IV (Vandrey et al, 2005). Although the DSM IV states that "there is some evidence that a majority of chronic users of cannaboids report histories of tolerance or withdrawal", withdrawal is not accepted as one of the diagnostic criteria for dependence (Cornelius et al, 2008, pg. 1500). This dismissal of marijuana withdrawal, consequently casting doubts on the credibility of there being a valid marijuana dependence syndrome, coupled with the increasing recreational use of marijuana, may help explain why the Runciman Report (Runciman, 1999) found that across all ages of those surveyed, from 11 years old and upwards, only 33% judged cannabis to be harmful or very harmful. This is surprising since Curtis (2007)

highlighted how individuals who smoke marijuana on a daily basis have a 200% increased risk of psychosis. Marijuana use has been found to increase the likelihood of an individual, who is pre-exposed to mental health problems, displaying psychotic symptoms and heavy use has been associated with paranoia and psychotic states in previously healthy individuals (FRANK, 2009). A study conducted in the US found that occasional use of marijuana during the teenage years produces a higher risk of suffering drug related problems in adulthood and those who do use marijuana on a weekly basis are 12 times more likely to experience such drug related problems, as well as being more likely to use other illicit substances (Devlin, 2010). However, irrespective of such information, research points out that current and past adolescent marijuana users show a tendency to refer to marijuana use as a way to relax and deal with stress and that they are also less likely to define it as an illegal substance in comparison to non marijuana users (Plancherel et al, 2005). This growing image indicating that marijuana/ cannabis use is becoming increasingly popular with a large proportion of society not perceiving its use as problematic or harmful prompted Finnegan (2009) to pose the question “why is cannabis such a popular drug, with many users being long term ones, if it is supposed to be non-dependant or non-addictive” (Pg. 36).

If Marijuana is indeed “non-dependent or non-addictive” (ibid) then perhaps it may be assumed that users would not experience craving for the substance. Though, with developments in research, evidence of the existence of marijuana dependence and marijuana withdrawal is increasing (Budney et al, 1999; Budney et al, 2001; Coffey et al, 2002; Toates, 2007). This study will seek to detail the concept of craving and the theory of cue reactivity in relation to drug use, finally concentrating on marijuana use in particular. The experiment carried out within this research investigates the relationship between levels of marijuana craving and exposure to relevant pictorial cues. Cue reactivity theory indicates that levels of marijuana craving should increase when users are exposed to marijuana related cues.

There is a plethora of research available exploring the concept of craving. According to the Oxford Library of Words and Phrases (1990) the word ‘crave’ is derived from the old English terms “beg for” and “yearn for” (Pg. 103). There appears to be an underlying assumption that craving is responsible for compulsive drug use and is, therefore, a major building block of many of the scientific and popular

conceptualisations concerning addictive behaviour (Roderique-Davies, 2008). However, Psychology has yet to provide a definitive definition, which has gained a majority consensus, regarding as to what craving can actually be defined as being. Ludwig & Wikler's (1974) study examined the concept of craving, explaining how craving may be considered as a desire to gain relief from the experience of withdrawal, as a result, indicating that craving may actually be a key factor when regarding reasons for relapse. Craving has also been referred to as psychological dependence in which craving is the main cause of drug relapse after long periods of abstinence (Cami & Farre, 2003). In relation to drug use, craving in general is usually considered as a desire to use a drug (Sayette et al, 2000). A meeting between the United Nation Drug Control Programme (UNDCP) and the World Health Organisation (WHO), in 1992, led to the development of a definition of drug craving as a "desire to experience the effect(s) of a previously experienced psychoactive substance" (as cited by Roderique-Davies, 2008, pp.265). Toates (2007) defined drug craving as "an urge to take a drug and mental occupation with obtaining it" (Pg. 450). It is from these two combined perspectives of drug craving that the reported study approaches the concept of craving.

Taking note of the interchangeable use of the term 'urge' and 'crave', although deliberation over the meanings of these two terms exists (Kozlowski et al, 1989), Tiffany et al (1993) determined, when developing the cocaine craving questionnaire, that research has yet to provide any substantial evidence in regards to a difference between the two terms. In relation to Toates' aforementioned definition, the 'urge' to take a drug may be elicited via associating drug use with certain stimulus. In this case, it has been argued that craving can be brought about due to learned association; therefore, classical conditioning can be applied. Pavlov's famous example, as described by Childress et al (1993) details how dogs learnt to associate the sound of a bell being rung; the unconditioned stimulus, with the arrival of food, to such an extent that the sound of the bell ringing became a conditioned stimulus capable of eliciting a conditioned response; in the example of Pavlov's' dogs, causing them to salivate over the expected arrival of food. Childress et al (1993) went on to discuss that a possible reason for drug relapse may be due to exposure to conditioned, drug related, stimulus triggering strong cravings as "drug patients

may have learned associations between a large number of stimuli and the effects of their drugs” (Pg.74).

The notion of craving as a conditioned response has been widely explored and expanded upon especially in relation to reasons for relapse, as Drummond et al (1995) stated that “relapse only occurs, by definition, in the presence of the drug and often takes place when the individual encounters other cues which have been previously associated with drug use” (Pg. 1). Carter & Tiffany (2001) wrote that “during an individual’s history of drug use, certain stimuli, such as environmental contexts or drug paraphernalia reliably accompany drug administration. It is assumed that these stimuli, by virtue of their pairing with unconditioned drug stimulus, become conditioned stimuli capable of eliciting conditioned responses” (Pg. 183). To elaborate on an example given by Totes (2007, Pg. 449) a neutral, or unconditioned stimulus, such as a syringe, may become associated with a drug if it is used, for example, to administer the substance e.g. using the syringe to inject heroin. Consequently, due to such association, the syringe alone will become a conditioned stimulus capable of evoking a sense of craving for the drug; a conditioned response. It is almost as though the syringe acts as a cue prompting the users’ memories of previous drug use and any positive associations the user may have or of had with the drug. “ Cues are thought to trigger a series of responses including generally, urges to consume the drug, positive outcomes, expectations for drug use and physiological activation” (Niaura, 1988, Pg. 145). Although it is important to draw attention to the fact that craving has not just been explored within the realms of classical-conditioning based theory, and other theoretical stances such as social learning theory offer alternative perspective.

Cognitive social learning theory in regards to drug addiction and relapse was proposed by Marlatt & Gordon (1985) referring to how drug abstinent individuals, when in a high risk situation (exposed to drug related stimuli), rely on their self efficacy: their confidence within themselves to resist the temptation and their outcome expectancies: whether they believe the consequence of relapse will be positive or negative (as explained by Drummond, 2001). Drummond (2001) observed that within cognitive social learning theory, craving is apparent via the expectation of positive outcomes from the drug use with such expectations relating to a desire for the positive effects. A conditioned incentive model of craving has also

been developed (Stewart, de Wit & Eikelboom, 1984), in which stimuli paired with drug use become positive incentives which encourage drug use and a want for the positive emotional rewards of drug use. Tiffany (1995) described the conditioned incentive model of drug addiction and craving as when “conditioned incentive stimuli elicit a motivational state that directly primes drug taking behaviour” (Pg. 54). However, the main area of importance is that in relation to drug addiction especially, reactivity to drug cues has been noted in research involving both animals as well as humans (Drummond et al, 1995).

The idea of drug paraphernalia becoming conditioned stimuli and therefore acting as cues to instigate feelings of cravings has been explored within the realms of cue reactivity theory. Carter & Tiffany (2001) defined cue reactivity as “the difference in responding to the drug-relevant cue compared to the drug neutral one” (Pg. 183). Cue reactivity theory, in relation to this study, can be used to compare an individual’s level of response, e.g. craving, for a certain drug, when exposed to stimuli/cues associated with the chosen drug compared to neutral stimuli/cues. “The assumption underlying the paradigm is that the presentation of drug related stimuli, activates motivational processes that are central to the maintenance of drug use” (Warthen & Tiffany, 2009 Pg. 70).

The range of cues that may be relevant within cue reactivity theory is potentially everlasting. Drummond et al (1995) detailed how a cue can be as basic as a sight or smell, or that more complex exteroceptive cues may involve things such as the ‘cook- up’ ritual and temporal cues such as the time of day the drug is normally used may all elicit craving. Individuals will associated numerous things with their drug of choice, all which may evoke past memories of use and/or a desire to use the substance. Carter & Tiffany (2001) found that overall, irrespective of drug choice, addicts reported an “increase in craving and exhibit modest changes in autonomic responses...when exposed to drug stimuli” (Pg. 183). This is supported by Roderique-Davies (2008) who stated that “a major determinant of drug-use behaviour in the natural environment is likely to be the presence of exteroceptive drug-related stimuli or cues” (Pg. 271). A vast quantity of research is widely available, in which their findings uphold these statements. One such piece of research involved a meta-analysis of cue reactivity studies, concerning cocaine, heroin, tobacco and alcohol cravings, revealing that when exposed to drug related cues participants across all

drug types showed significantly higher self reported levels of craving in comparison to those exposed to neutral stimuli (Carter & Tiffany, 1999). However, this meta-analysis did not include any studies focusing upon cue reactivity and marijuana craving. There has been a considerable volume of research, regarding cue reactivity and craving, which has been carried out with reference to cocaine, tobacco, heroin and alcohol use (Rohsenow & Niaura, 1999; Carter & Tiffany; 1999, Conklin et al, 2008). Though, in the light of marijuana use causing recent debate within society it does appear to have been largely overlooked. This is of significance, as while various drugs of abuse may have similar effects on the mesocorticolimbic dopamine system, they have different pharmacological properties and, as a result, may not produce identical forms of addiction (Roderique-Davies, 2008). Due to such differences it is important that craving for and addiction to different types of drugs, be it alcohol, cocaine or marijuana etc, be explored individually.

The main psychoactive ingredient within marijuana is delta-9-tetrahydrocannabinol (THC), which can produce changes in the quantity of different chemicals in the brain, such as dopamine and serotonin levels which control ones mood and emotion, generally producing euphoric effects; colours appearing brighter and emotions seeming more meaningful; Though negative psychological effects, for example anxiety, depression and psychosis, may also be produced (Darton, 2007). Nevertheless history indicates that marijuana has been used for over 4,000 years for recreational and healing purposes (Stahl, 1998; Toates, 2007). References have been made to the properties of marijuana (cannabis) in Chinese texts, dating as far back as 2,700 BC (FRANK, 2009). In 1753 the official name of cannabis sativa was given to the plant by Carl Linnaeus and in the late 1800s Queen Victoria was given the substance by her doctor to relieve period pains (Panorama, 2005). Panorama (2005) reported an intriguing timeline of marijuana/cannabis use through-out British history, detailing how the British imposed regulation and taxes on all forms of marijuana use in the British colonies of India back in 1793, though recreational use of marijuana was not officially made illegal here in the UK until 1928, under the Dangerous Drugs Act. Yet, regardless of the colourful history of marijuana, the concept of marijuana craving appears fairly recently in research in comparison to the vast quantity of papers focusing upon craving and other substances. This is surprising as research has indicated that use of marijuana may act as a gateway

towards use of other illicit substance (Hyman & Sinha, 2009). Though the lesser interest in marijuana may be due to the view of other such illicit substances, such as heroin and cocaine, perhaps being seen as more problematic in society with more apparent physiological withdrawal and dependence affects, as there was a long term belief that marijuana did not produce any withdrawal or physical dependence (Kleber, 2005).

Budney et al (1999), however, concluded that a valid marijuana syndrome does occur. Budney (2001), in a more recent research report, commented on how “behavioural and emotional withdrawal symptoms, commonly associated with various drug withdrawal syndromes as well as marijuana withdrawal could perhaps be more important than the physical symptoms in relation to development of marijuana dependence and relapse” (Pg. 923). In Budney’s (2001) study assessing marijuana withdrawal and dependence, Budney et al (1999) found that more than 40% of their participants reported affective and behavioural withdrawal symptoms. Symptoms reported included irritability, restlessness, increased anger, reduced appetite and craving (Budney et al, 1999). Craving, therefore, may be an important factor in understanding why “many marijuana users have difficulty quitting and maintaining abstinence” (Budney et al, 1999, Pg. 1311). Coffey et al’s (2002) study comparing cannabis dependant participants and alcohol dependant participants found that “dependant cannabis users reported compulsive and out-of-control use more frequently than dependant alcohol users, withdrawal similarly and tolerance considerably less often” (Pg.187). As levels of withdrawal in cannabis dependence participants were similar to that of alcohol dependence participants this once again highlights how craving, a symptom of withdrawal, may be an important factor in the maintenance of marijuana use. Coupled with “compulsive and out of control behaviour” (ibid) this is especially useful as two-thirds of dependant marijuana users who participated in the study reported experiencing persistent desire for marijuana as well as unintentional use, confirming a pattern of craving during abstinence leading to relapse (Coffey et al, 2002). Having indicated the importance of craving in the continued use of marijuana, the next step would be to examine situations or stimulus that may increase a user’s level of craving.

Previously, it has been alleged that a negative mood may increase the chance of an individual relapsing, by evoking a sense of craving and subsequently a relationship

between negative affect and craving has been proposed (Roderique-Davies, 2008) . Back in 1987, Childress et al conducted a study exploring the effects of various mood states upon levels of withdrawal reported by opiate users. The study concluded that negative moods, e.g. anxiety and depression, can be regarded as factors which may activate conditioned withdrawal or craving in opiate abusing patients and that mood alone is sufficient enough to effect levels of withdrawal and craving (Childress et al, 1987). Such findings indicate that an individual's mood may play an important factor contributing to the manifestation of craving, other than just exposure to associated cues. Litt et al (1990, as described by Greeley & Ryan, 1995) conducted a study in which hypnotic suggestion was used to induce a negative or neutral mood in alcohol dependant participants. Their participants were then either presented with their favourite alcoholic beverage or water; acting as the drug related and neutral cues, respectively. Litt et al's (1990) study found that "only during induction of the negative mood states did subjects report an increased desire for alcohol when alcohol cues were present and in some subjects the negative mood state alone was sufficient to elicit desire for alcohol" (as cited by Greeley & Ryan, 1995, pg. 130). Wilner & Jones (1996) reported similar findings in their study investigating cigarette craving, revealing that induction of a depressed mood increased levels of self reported craving on the Questionnaire of Smoking Urges (QSU). Induction of a depressed mood has also been found to increase levels of self-report craving on the multi-dimensional Desires for Alcohol Questionnaire (DAQ) (Wilner et al, 1998). Interestingly, similar to Litt et al's (1990) aforementioned findings, in the study carried out by Wilner et al (1998), the generation of a depressed mood increased levels of craving for both the research groups; one of which was exposed to alcohol related cues and one of which was not. However, when considering marijuana use, there appears to be a different picture.

Research has found that a depressed mood and the effects of life stress may increase a user's likelihood of relapsing (Tate et al, 2008) and that marijuana use is perhaps turned to as a way of dealing with or relieving a depressed mood (Harding, 2009). Studies have revealed that marijuana users may use marijuana as a form of self medication to deal with stress, anxiety, grief and trouble sleeping, as well as aversive internal states such as depression (Kleber, 2005; Harding, 2009; Hyman & Sinha, 2009). Though, on the other hand, it has been reported that use of marijuana

can decrease the likelihood of an individual experiencing a depressed mood. Green & Ritter (2000) concluded that “marijuana use may in fact reduce depression”, (Pg. 47) by finding a negative relationship between marijuana use and depression. The mildly euphoric affects of marijuana use were offered as an explanation for this finding (Green & Ritter, 2000) and a similar conclusion, concerning depression and marijuana use has been replicated in a more recent study. Dennson & Earleywine (2006) conducted an online survey with 4, 400 participants, measuring depression and marijuana, finding that daily marijuana users reported less depressed moods and more positive affects than non marijuana users. Though, as the study indicated that less negative effect was only found in daily users, a level of dependence may be apparent. Therefore, craving needs to be taken in to account alongside the individual participants’ levels of dependence.

Filbey et al’s (2009) research, involved monitoring functional magnetic resonance imaging (fMRI) scans of marijuana users when presented with marijuana related cues and neutral cues; finding that exposure to marijuana related cues produced significantly higher reactions in the blood oxygen level dependent (BOLD) within numerous areas of the brain; such as the VTA, dorsal anterior cingulate cortex, cerebellum, thalamus, amygdala, fusiform gyrus, pre and post central gyri, inferior parietal lobe and the superior temporal gyrus. Yet the most important finding of this research was that the level of BOLD response in many of the areas previously listed was significantly positively correlated with the severity of marijuana- related problems (Filbey et al, 2009). Consequently, although marijuana related cues have been found to elicit significant neuro-chemical responses in marijuana users, it has been implied that the higher the individual’s dependence to the substance the more prominent the response will be. Therefore, a negative mood such as depression and whether a marijuana user is dependant or not can seriously affect the individuals’ level of craving. However, there has been more research conducted concerning the effects of mood and dependence on marijuana craving and withdrawal than of cue reactivity and marijuana craving.

Gray, LaRowe and Upadhyaya (2008) carried out a preliminary investigation of cue reactivity in young marijuana smokers, to investigate if exposure to marijuana related cues would elevate levels of craving in users, compared with those exposed to neutral cues. Their small scale study involving fifteen adolescent participants,

predicted that “participants would show greater craving and physiological reactivity in response to marijuana cues” (Pg. 583). The study used the 12 item version on the Marijuana Craving Questionnaire (MCQ), which participants were required to complete at the start and end of the study as well as after exposure to each of the three neutral cues and the three marijuana related cues. Three different types of cue presentation were used: auditory imagery script, video cue and vivo-cue handling procedures. The findings concluded that “greater craving and skin conductivity were observed during the presentation of marijuana cues relative to neutral cues” (Grey et al, 2008, pg. 585).

It is from this study that the concept of the current research was developed. By using a larger sample of participants across a wider age range, this study aims to support the findings of Grey, LaRowe and Upadhyaya (2008). Taking in-to account other research reviewing factors affecting craving and research on the cue reactivity theory, the study will also record participants’ levels of depression and dependence to marijuana. Research has concluded that symptoms of marijuana withdrawal, such as anxiety and craving, are more common amongst marijuana users who are dependent and/or exhibit high levels of depression (Cornelius et al, 2008). The study predicts that high levels of depression and/ or high levels of dependence will be associated with high self reported levels of craving. The studies one-tailed hypothesis maintains that exposure to proximal cues will produce higher levels of craving on the MCQ amongst marijuana users compared to users exposed to no cues.

Methodology

Materials

The MCQ is a multi-item form of assessment chosen as previous studies measuring craving have been criticised due to less than 10% of the research having used a multi-item assessment technique (Carter & Tiffany, 1999). In addition to this, whilst reviewing research upon craving, Roderique-Davies (2008) stated that “craving, for a variety of different abused substances is multi-dimensional in nature and comprises at least two dimensions or factors” (pp. 267-268). The MCQ assess four dimensions of craving: compulsion, expectancy, emotionality and purposefulness. The compulsivity factor measures a respondent’s inability to control their marijuana use; expectancy examines the users anticipation or expectance of positive outcomes from the use of marijuana; emotionality highlights the respondents expectation that marijuana use will provide relief from withdrawal or a negative mood and the final contributing element, purposefulness, considers the respondents intention and planning to use marijuana for positive outcomes (Heishman et al, 2001). A 12 and 47 item version of the MCQ is available, both measuring all four aforementioned dimensions of marijuana craving. In this instance the 47 item version was used (see appendix one) in order to gain as much detail on the respondents level of craving as possible.

The questionnaire has been previously tested and found to be a valid and reliable measure of marijuana craving (Heishman et al, 2001). Heishman et al (2001) reported that “the vast majority of respondents reported that the instructions (100%) and questions (96%) were clear, precise and understandable and that the items were appropriate for the subject of craving (88%) and that other people like themselves would understand the questions if they were participating in this research (99%)” (Pg. 103). Singleton et al (2002) also verified the MCQ as a valid and reliable test of marijuana craving. The MCQ was used to assess 48 marijuana users levels of craving after auditorily presented imagery scripts; self reported craving was found to significantly increase on factors 1, 3 and 4 on the MCQ, after exposure to the scripts and examination of the homogeneity of items contained within the four factors found no significant departure from uni-dimensionality (Singleton et al, 2002).

Although the main emphasis of the research relies upon the analysis of the MCQ responses from the two conditions, the Leeds Dependence Questionnaire (LDQ) was incorporated and altered to measure levels of dependence in relation to marijuana use alone (see appendix two). The Beck Depression Indicator (BDI) was also included (see appendix three) to assess negative mood state and the affect of the participants levels of depression upon levels of self-reported craving.

Carter and Tiffany (2001) highlighted a flaw in cue-reactivity research, in which in a majority of studies self-report details of craving are often collected after cue presentation, rather than in the presence of cues; a memory bias may be apparent when using such retrospective rating. Due to this, in the cue exposure condition, each of the 47 questions of the MCQ were asked simultaneously with the presentation of a different generic marijuana related pictorial cue (see appendix four). The picture cues were sourced via an online search engine and generic proximal cues were chosen as use of generic cues has been previously found to elicit craving responses from cigarette smokers (Conklin et al, 2008).

Participants

An independent group design was used for this research investigation, in which participants, who were not matched to each other, were randomly assigned to one of the two conditions. 59 participants were involved in this study; 37 males and 22 females with an age range of 18 to 51 years old (Mean age = 25). A snowballing sampling method was used to gain participants. Social networking sites were the primary source of contact with participants in which the link to the online questionnaire was passed to self admitted marijuana users who were asked to then pass the link on to other marijuana users and so on and so forth. The sampling method was selected due to the illicit nature of marijuana use and to avoid being seen to promote use by openly advertising for participants. Participants were required to give consent to participate before being able to access the questionnaire, and all participants were informed of the details of the study, their right to withdraw from the study and that the University in no way encourages the use of marijuana; with information on seeking help concerning marijuana use being made available (see appendix five).

Procedure.

The questionnaires were administered via the internet in order to ensure that participants remained anonymous, as only the age and sexes of the participants were required. It also allowed increased confidentiality as participants individual answers were not stored as hardcopies and were only accessible online with access to the researchers personal, password protected account. The questionnaires were compiled using Ultimate Survey. Two questionnaires were created, both including the 21 question BDI, the 10 item Leeds Dependence Questionnaire and the 47 item MCQ. Although the questions included and the order in which the questions were presented was identical for both of the questionnaires, there was one fundamental difference. The one questionnaire, used in the second condition; the cue exposed condition, contained generic marijuana related pictorial cues. A different pictorial cue was presented simultaneously with each of the 47 questions from the MCQ. Participants were randomly assigned to either group one; the no cue condition, or group two; the cue exposed condition, depending on which online questionnaire link they received. Upon following a link to the questionnaire and consenting to participate, participants were then simply required to respond to the displayed questions by clicking on the answer that best suited them, with instructions displayed on screen. Group 1, the non cue exposed condition, consisted of 27 participants (Male: 15, Female: 12) with 32 participants in cue exposed condition; Group 2 (Male: 22, Female: 10).

Results.

Once the data was gathered it was inputted in to SPSS and using the factor score procedure available in SPSS the overall scores relating to the four factors of craving measured within the MCQ (MCQF1: compulsivity, MCQF2: emotionality, MCQF3: expectancy and MCQF4: purposefulness) as well as a general factor of craving (MCQGF), and an overall BDI and LDQ score were computed for each participants.

Originally a multivariate analysis of variance (MANOVA) was considered the best option, as it allows numerous different aspects of the dependent variable to be analysed, i.e. the four factors; compulsivity, emotionality, expectancy and purposefulness, which are all measured within the MCQ as various aspects contributing to the dependent variable: craving. However, upon running a t-test beforehand it appeared that there was a significant difference in the level of dependence amongst the group 2 participants in comparison with the group 1 participants.

However, a t-test was carried out beforehand. Interpretation of the t-test output (see appendix six) highlighted that the mean score indicating participants levels of depression, measured by the BDI, was higher for group two ($M = 9.645$, $SD = 7.508$) than for group one ($M = 8.1852$, $SD = 8.823$). Though this was not found to be a statistically significant difference ($t = -0.681$, $df = 56$, one-tailed $p = 0.250$). The dependence scores, measured using the LDQ, were also found to show that group 2 had a higher mean score ($M = 12.75$, $SD = 7.466$) than the mean score for group 1 ($M = 9.111$, $SD = 5.287$). However, in this case the results from Levenes test ($sig. = 0.015 < 0.05$) determined that equal variances were not assumed and that the level of dependence of participants in group 2 was significantly higher than of those in group one ($t = -2.184$, $df = 55.446$, one-tailed $p = 0.017$). Research by Niaura et al (1988) indicates that an individual's history with a substance may affect the strength of the observed cue reactivity response, therefore an individual's level of dependence will relate to their level of response; those with higher levels of dependence are more likely to exhibit cravings regardless of exposure to cues. Due to this finding the results from the LDQ tests were incorporated as a covariate in the MANOVA, in order to ensure that any difference found between the two groups was due to cue-reactivity and not dependence. Therefore, a one-way multivariate

analysis of co-variance (MANCOVA) was used to analyse the data (see appendix seven).

The four factors of craving alongside the general factor measuring craving were allocated as the dependant variables; with the overall LDQ score as a covariate. The output produced by performing the MANCOVA calculated the mean scores for each of the four factors (compulsivity, emotionality, expectancy and purposefulness) from group 1 and group 2.

Table 1

Mean Scores for both groups on the four factors of the Marijuana Craving Questionnaire

	Group 1	Group 2
MCQ1	2.8245	3.7321
MCQ2	4.1389	5.1875
MCQ3	4.0864	4.9375
MCQ4	3.9196	5

As the table above highlights, the mean scores for each of the four factors of craving were consistently higher for group two, the cue exposed group, than for the group not exposed to any marijuana related cues; group 1. However, with the consideration of the LDQ scores as a covariate, the MANCOVA found the difference not to be statistically significant. The multivariate test showed no significant effect of the exposure to marijuana related cues on the dependant variable of craving: $F(4,53) = 1.72$, $p = 0.115$; $Wilks \lambda = 0.159$. Therefore, no statistically significant difference was found between those exposed to marijuana related cues and those not exposed to cues, in relation to their self-reported levels of craving.

The results of this study did not support the hypothesis, finding that exposure to marijuana related cues did not produce any statistically significant increases in levels of reported craving on the MCQ.

Discussion.

Although the current research did find a greater mean score on all four factors of craving measured by the MCQ, for participants exposed to cues (group 2) in comparison with those who were exposed to no cues, this difference was not found to be statistically significant at a level of significance of 0.05 or less. Therefore, the research indicates that exposure to marijuana related pictorial cues did not have a significant effect on the participants self-reported levels of craving. This finding is contradictory to previous research on cue reactivity and the findings of the preliminary study conducted by Grey et al (2008), in which exposure to marijuana related cues was found to have a significant effect on levels of craving. However, unlike the presently reported study, the study carried out by Grey et al (2008) investigated the effects of three different types of cues; auditory imagery scripts, video cues and in-vivo cue handling, as well as monitoring participant's physiological reactions. As the method chosen in the reported research concerned the questionnaire being distributed and completed via the internet, collecting information on participant's physiological reactions was not an option. For the same reason, pictorial cues were opted towards as the most appropriate to integrate in to an online questionnaire. The differences in the cues presented between the two studies may attribute to the difference in findings. Use of pictorial cues may have had less of a cue reactive effect; provoking lower levels of craving, as drug expectancy has been found to be lower when pictorial cues are used in comparison to real drug cues, e.g. in-vivo cue handling (Glautier & Tiffany, 1995). On the other hand, pictorial cues may not have been the only cues apparent in the questionnaire.

Field et al (2004) conducted a visual probe task in which it was found that marijuana users exhibited an attentional bias towards marijuana related words, as the participants gaze were directed towards such words for longer than their gaze focused upon the neutral words. Field, Mogg & Bradley (2004) reported the conclusion that "regular drug use will be associated with evaluative and attentional

biases for drug related cues” (Pg. 105); where individuals who, on a frequent basis, use a substance such as marijuana they will be more bias towards evaluating a drug related cue as positive, with their attention being bias towards the drug related cue over other stimuli. This research investigation involved 17 marijuana users and 16 non users, who all par-took in an implicit association test (IAT) as well as a visual probe test, in which marijuana related words were presented; such as cannabis, marijuana, spliff, stoned, weed and joint as well as neutral words, e.g. sweater, sand, cliff, fog and holly (Field, Mogg & Bradley, 2004.) . The study found that non marijuana users were significantly more likely to evaluate the marijuana related words as negative on the IAT and that a significant attentional bias towards the marijuana related words was found from the marijuana users during the visual probe test (Field, Mogg & Bradley, 2004). Such findings indicate that marijuana related words may, themselves, act as a cue to elicit a sense of craving. Field (2005) conducted further research in to this concept, carrying out a stroop test using marijuana related words and neutral words, alongside measuring participants levels of craving and dependence. The research investigation supports the previous findings in which a significant attentional bias towards marijuana related words was found as well as the conclusion that such attentional bias was also associated with subjective craving (Field, 2005). Research of this kind, indicating that marijuana related words alone can produce an attentional bias from marijuana users; consequently impacting upon their levels of craving, has important implications for craving research including the current study.

Within the questionnaire distributed for this research study the word marijuana is used 56 times and the word ‘joint’; in relation to smoking marijuana, is used four times. If past research investigations have concluded that marijuana related words are subject to attention bias from users which can impact on craving, the repetition of the actual word ‘marijuana’ within the questionnaire may have elicited a sense of craving, regardless as to whether the pictorial cues were present or not. As the same fundamental questionnaire was used for both group 1 and group 2, the repetitive use of the word marijuana may have, unintentionally, acted as a cue in the no-cue condition in turn effecting their sense of craving. The fact that the group one; the no cue group could be considered as being indirectly exposed to cues, via the repetitive

use of marijuana related words, may explain why the difference between the two groups was not statistically significant.

The conflicting difference in the results may also have been affected by the design. The independent design measure employed meant that participants weren't matched to each other within the two groups, therefore various backgrounds, social economic statuses, unequal numbers of males and females and a range of different levels of dependence were apparent which may not have been the same in both groups. Participant's individual differences may also have meant that some participants involved in the study did not respond to the cue reactivity manipulation. Rohsenow et al (1992) gave details concerning how not everyone demonstrates cue reactivity, with their study finding that 30% of the alcohol dependent participants involved did not react to alcohol related cues via exhibiting increased craving for alcohol. This is supported by Rees & Heather (1995) who, whilst reviewing cue reactivity research, drew attention to the fact that "in several cue reactivity studies it has been reported that a large proportion of subjects showed little or no response to a cue exposure manipulation" (Pg. 100). The finding that the difference between the two groups was not statistically significant may be due to individual differences of the participants.

Other than participants' individual differences other external, uncontrollable factors may have had an effect on the participant's results. In relation to completing the LDQ, participants may have given more socially desirable responses, perhaps wanting to portray less of a dependency on marijuana than is actually true. As the research was not carried out in a laboratory setting, with no clinical assessments, the reliance was on the participants self reported information concerning their levels of dependence, depression and craving which may not have been wholly accurate or reliable.

As participants were able to access the questionnaire online they were able to complete the assessment in various different environments. Those in the no cue condition may have had external cues present in their surrounding environment. Participants may also have accessed the questionnaire from a public or work computer in which case, due to the illegality of the substance, they may have not been wholly honest and may have rushed their responses; once again perhaps providing more socially desirable response due to their environment. It is also

unknown if participants were using marijuana or were under the influence of marijuana during completion of the questionnaire. Such factors may have had an impact on their self reported level of craving, especially as research suggests that “craving should be more pronounced when addicts have the opportunity to consume their target drug either during or immediately after the cue reactivity session” (Carter & Tiffany, 2001).

The way in which marijuana users consume marijuana may also have an effect on craving. Marijuana can be smoked on its own, via use of a pipe, though most commonly marijuana is mixed with tobacco to be wrapped like a cigarette and smoked (FRANK, 2009). Combining marijuana and the nicotine from the cigarette tobacco mixes two substances which the user may thereafter experience craving for. Budney et al (2001), compared marijuana withdrawal and nicotine withdrawal and concluded that, in reference to marijuana use, “withdrawal effects appear similar in type and magnitude to those observed of nicotine withdrawal” (Pg. 917). In relation to craving, it may be of interest in future research to differentiate those marijuana users who use cigarette tobacco and those who do not, as nicotine addiction may be contributing to any increased cravings for marijuana. A study of 176 university students who reported using marijuana on a casual basis or as a regular occurrence, found that there was an increasing tendency to mix marijuana with tobacco and alcohol use more than with other illicit substances, and that the biggest health risk was posed by the use of tobacco to smoke marijuana (Hammersley & Leon, 2006). Hammersley & Leon (2006), concluded that there needs to be an initiative to dissuade marijuana users from smoking the substance with tobacco.

From a theoretical perspective the findings of this study could have implications for marijuana treatment. Cue Exposure Therapy (CET) involves trying to control and to therefore decrease addicts levels of reactivity to drug related cues by exposing them to such cues, whilst preventing them from their normal response of drug use (Marissen et al , 2007). Treatment of this sort has been developed from classical conditioning and the cue-reactivity paradigm aiming to reverse such effects; “repeated presentation of a cue while preventing the usual response should result in decreasing reactions across sessions and possibly the permanent loss of the elicited response over time” (Monti & Rosenhow, 1999, pg. 112). CET has been used as an effective treatment for alcohol dependency (Monti et al, 1993; Drummond & Glautier,

1994; Sinarthan et al, 1997), though there has been mixed results as to the overall effectiveness of CET as a treatment for drug dependency. Marissen et al (2007) conducted a study using 127 heroin dependent participants, who either received cue exposure therapy or placebo psychotherapy. The study concluded that CET had not been as effective as hypothesized, as after 3 months the drop-out rate for the CET group was significantly higher than that of the control group (50.8% and 22.6%, respectively); the relapse rate was also found to be higher for the CET group (40%) than the control group (12.9%). In relation to the current research study, use of CET to treat individuals who are marijuana dependent may not be the most effective method, if in fact cue reactivity does not have a significant effect on marijuana user's levels of self reported craving, as concluded by this research. However, a need for more research into the cue reactivity paradigm in relation to marijuana use is suggested before use of CET as a possible treatment of marijuana dependence.

Even though the research reported did not find a significant effect of marijuana related cues on the participant's levels of craving, a slight difference between the two groups was apparent. At the time of writing and to the authors' knowledge, there is no similar research available investigating the effects of exposure to marijuana related pictorial cues on self reported levels of craving on the MCQ, via an internet questionnaire. Additional research is required concerning the effects of cue-reactivity on marijuana craving and use. Glautier & Tiffany (1995) highlighted that "relatively few studies have examined the impact of manipulation of drug cues on drug use behaviour" (Pg. 87). This is true of research concerning marijuana use.

Repetition of the current research study would require a larger sample size and separation of dependent and recreational users so as their levels of reactivity can be compared. Also, as suggested by Childress (1993) a control group of non-drug users to test the cues would make the results more reliable. In relation to the previously discussed research, indicating that the use of marijuana related words themselves may act as cues to elicit cravings, further research is required in to the extent of this effect especially in consideration of the use of the MCQ.

In review of the current research investigation, in order to assess the full effects of cue reactivity and marijuana craving and use, information should be sought as to whether, in the example of an online study, participants were using or under the

influence of marijuana whilst participating and whether an increase in drug seeking behaviour is apparent after exposure to marijuana related cues. Therefore, it is suggested that more longitudinal and/ or observational research is required, not just investigating cue reactivity and marijuana craving but the effects of exposure to marijuana related cues on drug seeking behaviour and patterns of use.

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