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Women Inmate Substance Abusers' Reactivity to Visual Alcohol, Cigarette, Marijuana, and Crack Cocaine Cues: Approach and Avoidance as Separate Reactivity Dimensions

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By

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This paper is dedicated to Sandy Jensen, my partner in everything. Thank you for your support, encouragement, assistance, and love. With you, even the hard stuff is fun – and for that I thank you and love you with all my heart.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In the present study, we evaluated the reliability, specificity, and validity of a set of visual alcohol, cigarette, marijuana, and crack cocaine cues in comparison to consumable non-drug control cues. The study extended a previously designed cue reactivity methodology, which was originally tested on a college student sample, to a clinical sample of substance abusers in a prison-based residential treatment program. The methodology is based on a multidimensional conceptualization that defines substance cue reactivity in terms of two separate but related dimensions: inclination to approach and consume the drug, and inclination to withdraw and avoid consuming the drug. Participants in this study were 155 incarcerated women who were participating in or waiting to begin participation in a nine-month drug treatment program. Participants rated the drug and comparison cues (food and non-alcoholic beverages) in terms of their arousing properties and their capacity to elicit separate approach and avoidance inclinations. Participants also completed a battery of substance-related individual difference measures. Results indicated that our alcohol, cigarette, marijuana, and crack cocaine cues had good reliability, and our cigarette, marijuana, and crack cocaine cues showed high specificity. Results also supported the utility of measuring approach and avoidance as separate dimensions, by demonstrating meaningful clinical distinctions between groups evincing different reactivity patterns, which were observable across three of the four drugs.

INTRODUCTION

Ambivalence about substance use, defined as the simultaneous desire to use and to refrain from using psychoactive substances, has been identified as the hallmark of addiction, and lies at the heart of many clinical formulations of substance use disorders (e.g., Orford, 2001; Heather, 1998; American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders, 4th edition, 1994). Yet, despite the widespread acceptance of the centrality of ambivalence in defining addictive behavior, this important concept has often been overlooked, particularly in the study of substance cue reactivity, or how individuals respond to cues as a function of their association with psychoactive substance use. The present study sought to address this oversight using a clinical sample with diagnosable substance use disorders and a unique picture-viewing methodology whose utility has already been established in non-clinical users (Stritzke, Breiner, Curtin, & Lang, 2004).

Theories that attempt to account for substance users' responses to drug cues typically focus on "craving", which has been defined as cue-elicited motivation to consume the substance (e.g., Wikler, 1948; Baker, Morse, & Sherman, 1987; Stewart, de Wit, & Eikelboom, 1984; Tiffany, 1990). Cue-elicited craving for a drug is thought to develop through a process of conditioning, in which drug-related cues are repeatedly paired with positively and / or negatively reinforcing drug effects (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Stewart et al., 1984; Niaura, Rohsenow, Binkoff, & Monti, 1988). Unfortunately, this conceptualization lacks the capacity to account for the ambivalence that substance abusers commonly display toward the drugs they abuse. The reason for this failure can easily be understood when substance abuse is considered in terms of psychopharmacology and learning theory.

Ingestion of psychoactive substances produces an array of short and long term effects. Many of these effects are reinforcing; that is, they might either produce a desired state such as euphoria (positive reinforcement), or alleviate a negative state such as anxiety (negative reinforcement). Cue reactivity theories correctly recognize that repeated exposure to reinforcing drug effects results in conditioned drug use motivation. What these theories fail to address adequately, however, is the fact that some drug effects at some times function as punishers; that is, their presence is perceived as aversive (e.g., nausea, fatigue, performance impairments, adverse interpersonal consequences, etc.). Under the principles of learning theory, repeated exposure to these aversive drug effects should result in conditioned drug avoidance motivation.

When drug reinforcement and punishment are both recognized, the resulting cue reactivity conceptualization would predict that exposure to drug cues can elicit two

distinct response components: appetitive motivation to approach and consume the drug, and defensive motivation to withdraw and avoid consuming the drug. According to the psychophysiology of learning and motivation, these two response components are governed by separate but interactive brain pathways (Larsen, McGraw, & Cacioppo, 2001; LeDoux, 2000; Davis & Lang, 2003). As such, drug approach motivation and drug avoidance motivation may manifest simultaneously. The intensity of these two response dimensions will vary depending on the schedule and strength of the respondent's drug reinforcement and drug punishment history, which may also include chemical and structural brain alterations, depending on the type of drug and the extent of use history. Clearly, this two-dimensional conceptualization of substance cue reactivity is an improvement over previous models, because it is capable of capturing the conflicted or ambivalent attitudes and behavior patterns that substance abusers often exhibit surrounding the drugs they abuse (Breiner, Stritzke, & Lang, 1999; Ostafin, Palfai, & Wechsler, 2003). Typically, ambivalence develops as the negative consequences of substance use begin to accumulate. Therefore, ambivalent reactivity toward substance cues is likely to emerge among moderate users, and to increase in intensity as severity of substance use increases.

We recently developed a cue reactivity methodology designed to elicit and measure respondents' self-reported approach and avoidance inclinations toward alcohol and cigarette cues. Within a college student sample, we found evidence of cigarette cue-elicited ambivalence among a subset of cigarette smokers who reported current or recent attempts to quit smoking (Stritzke, et. al, 2004). However, a major limitation of the initial test of our model was the relatively small number of participants in our sample who would have met diagnostic criteria for alcohol use disorders, and hence would have been particularly likely to respond with ambivalence to the alcohol cues presented in the study.

Thus, the present study was designed to extend the findings of the initial study, by specifically targeting a population known to include a rich saturation of substance abusers – incarcerated women. In the present investigation, we examined this population's reactivity to cues representing four psychoactive substances that incarcerated women commonly report abusing throughout their lifetimes: cigarettes, alcohol, marijuana, and crack cocaine. The primary goal of this study was to test the ability of our methodology to yield meaningful information about the cue-elicited approach and avoidance reactivity of a clinical sample of substance abusers within a prison setting.

REVIEW OF RELEVANT LITERATURE AND BACKGROUND INFORMATION FOR PRESENT STUDY

Before describing the study and the specific hypotheses we evaluated, it is necessary to provide a more thorough description of the development of our conceptualization of the primary dimensions of substance cue reactivity, approach and avoidance inclination. The following section describes the theoretical underpinnings of these dimensions, and provides a detailed rationale for casting these reactivity components as the central constructs of interest in this (and any) study of substance users' responses to drug cues. Our initial test of the methodology for eliciting and measuring these dimensions will also be described.

Approach and Avoidance Inclination: Primary Dimensions of Cue Reactivity

Within the field of substance cue reactivity, research over the past decade has been marked by a major shift in perspective toward theories that unite psychological, neurobiological, and pharmacological factors into broader conceptualizations of the cue reactivity phenomenon (e.g., Anton, 1999; Carter & Tiffany, 1999; Verheul, 1999; Heinz, Lober, Georgi, Wrase, Hermann, Rey, Wellek, & Mann, 2003). Earlier views of cue reactivity were unidimensional in nature, suggesting that all processes involved in the response to a substance cue (e.g., self-reported urge, psychophysiological indices, etc.) ultimately reflected a single dimension: *an increase in the individual's inclination to approach and consume the substance* (e.g., Wikler, 1948; Stewart et al., 1984; Niaura et al.,1988).

Spurred simultaneously by a marked lack of unequivocal empirical support for this view, and by the findings from a broad spectrum of methodological and technical advancements in diverse areas such as neuroimaging, psychopharmacology, endocrinology, animal models of conditioning and craving, and the psychophysiology of emotion, motivation, and cognition, the prevailing view today among investigators is that substance cue reactivity is a complex, multidimensional neuropsychobiological process that involves the activation of, and interplay among, specific brain pathways that regulate motivation, and which include components in both basic emotion and higher level cortical systems (Stewart, 1999; Anton, 1999; Robinson & Berridge, 1993; 2001; Drummond, Tiffany, Glautier, & Remington, 1995).

Cue reactivity theorists have come to agree that substance-related stimuli are likely to elicit "a range of covert and overt responses… [that] can include the activation of central motivational or affective states, overt emotional reactions, autonomic responses, and *tendencies to approach or avoid* the stimuli in the environment" (Stewart, 1999; italics added). Thus, in addition to acknowledging that cue reactivity comprises of a rather broad constellation of psychological and physiological processes, there has also been increasing acceptance of the idea that these diverse response domains may tend to vary somewhat independently of one another, reflective of differing aspects of reactivity (Sayette, Shiffman, Tiffany, Niaura, Martin, & Shadel, 2000; Carter & Tiffany, 1999; Stewart, 1999).

Recently, a few researchers have suggested that one of these independent response domains elicited by substance cues may be *aversive* reactivity, resulting in motivation to actively avoid consuming the substance (Stewart, 1999; Greeley, Swift, & Heather, 1993; Orford, 2001; Ostafin et al., 2003; Saladin, Drobes, Coffee, & Libet, 2002). It is interesting to note that two early theorists studying alcoholism (Astin, 1962; Heilizer, 1964) independently raised the idea that exposure to alcohol related cues induces an approach – avoidance conflict within problem drinkers. It appears that their work was long ignored by their contemporaries and subsequent cue reactivity empiricists.

Building on the idea that substance cues may elicit an avoidance response, we sought to provide a theoretical framework that could account for the development of *both* approach and avoidance reactivity in response to substance cues (Breiner, et. al., 1999). Drawing on the emotion and attitude research of Cacioppo and colleagues (Cacioppo & Bernston, 1994; Larsen, McGraw, & Cacioppo, 2001), we conceptualized cue-elicited approach and avoidance reactivity as orthogonal response dimensions, or substance-directed 'action dispositions'. Approach reactivity is operationally defined as an inclination to approach and consume the substance (e.g., "craving"), and is presumed to develop as a function of the reinforcing effects of psychoactive substance use, including pleasurable drug effects and relief of negative states. Avoidance inclination is defined as an inclination to withdraw and refrain from consuming the substance, which develops as a function of the negative consequences that follow the excessive use of psychoactive substances.

Using this framework, an individual's net response to a specific substance cue can be operationalized as a point falling within one of the four quadrants of 'evaluative reactivity space' formed by the intersection of the independent approach and avoidance response dimensions. The net response is characterized by the relative strength of activation of each dimension. A response consisting of a high level of approach and a low level of avoidance falls within the approach-oriented or appetitive quadrant. High avoidance paired with low approach results in an avoidance-oriented or aversive net response. A response consisting of high levels of both approach and avoidance falls within the ambivalent quadrant, while low approach paired with low avoidance results in an indifferent net response.

We argued that these two primary response dimensions develop within substance users through the similar but separate psychobiological systems that account for the myriad of changes (e.g., physiological, psychological, emotional, behavioral) that

follow repeated, systematic exposure to reinforcing and punishing events (LeDoux, 2000; Lang, 1995). We have posited that these two reactivity dimensions are the overt manifestations of the activation of neural substrates governing appetitive, reward-related motivation and aversive, harm-related motivation (Breiner, et. al., 1999: see Figure 1).

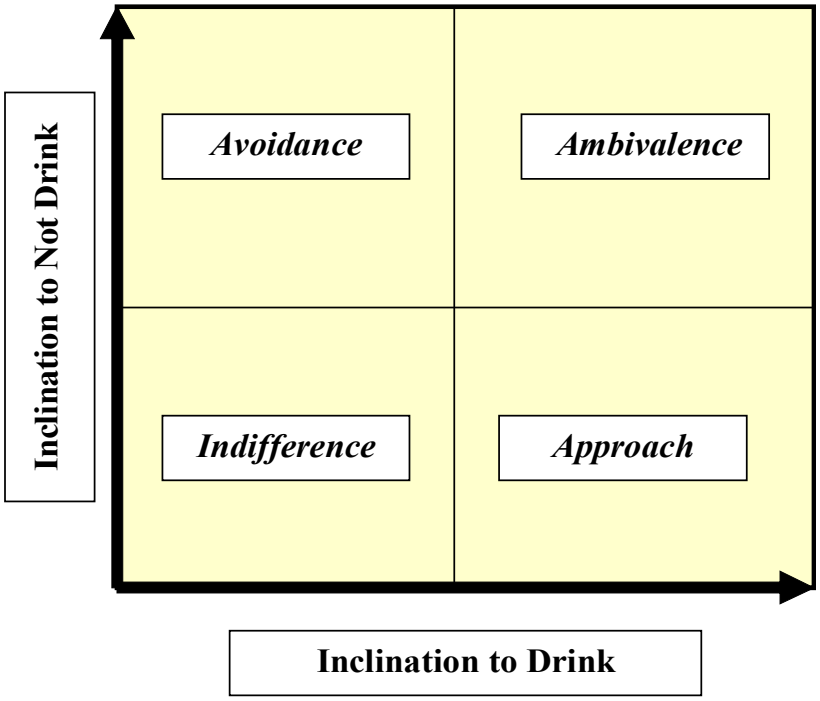


Figure 1: Primary Dimensions of Reactivity Space

When considered in the context of the diagnosis and treatment of substance use disorders, the fundamental nature of the concept of independent substance-related approach and avoidance motivation is obvious. The list of diagnostic criteria for substance dependence includes the "persistent desire for the substance despite efforts to cut down or control its use" (DSM-IV; 1994). Similarly, several recent theorists have explicitly suggested that ambivalence or conflict about substance use and the associated decisional processes should comprise the basis of the definition of addictive behavior (Orford, 2001; Heather, 1998). In Prochaska and DiClemente's

transtheoretical model of change (DiClemente & Prochaska, 1998; Prochaska, DiClemente, & Norcross, 1997), which describes the stages associated with changing addictive behavior, the competition between substance-related approach and avoidance motivation can be seen as the defining factor of each stage (e.g., precontemplation = approach motivation with no avoidance motivation; contemplation = competing approach and avoidance motivation, etc.).

In Motivational Interviewing, a stages of change-based substance abuse treatment approach, Miller & Rollnick (2002) make explicit the centrality of approach and avoidance motivation. In this therapy, the main therapeutic task is to assist the client in moving from one stage to the next by enhancing avoidance motivation and / or decreasing approach motivation.

In light of the compelling clinical significance of these two dimensions, it is more than a bit surprising to find that direct measurement of avoidance reactivity, as a separate dimension from approach, has been absent from all but a few cue reactivity studies to date. Greeley and her colleagues explicitly acknowledged the potential of alcohol-related cues to elicit avoidance inclination, and were probably the first to attempt to measure it (Greeley, Swift, & Heather, 1993; Greeley, Swift, Prescott, & Heather, 1993). Unfortunately, results of these studies were obscured by the use of a single bi-directional scale that forced participants to combine their approach and avoidance inclinations. Avants, Margolin, Kosten, and Cooney (1995) included a measure of inclination to avoid cocaine along with a measure of inclination to use cocaine in their cue exposure study with cocaine addicts, but they did not report their results in a way that reflects consideration of these dimensions as independent of one another.

In a recent study measuring alcoholics' responses to alcohol cues via startle probe reactivity, Saladin, Drobes, Coffee, & Libet (2002) measured "liking" and "disliking" of the alcohol cues on separate scales, but did not specifically measure approach and avoidance inclinations. These authors speculated that their finding that alcohol cues elicited an aversive startle response might be attributed to activation of an approach – avoidance conflict in their recently alcohol-abstinent participants.

Palfai, Ostafin, and colleagues (2003) recently developed a cognitive sequential priming task to assess alcohol-related approach and avoidance motivation among college student drinkers. In this series of studies, the strength of participants' approach and avoidance motivation were measured in the presence of alcohol-related and neutral cues. Results indicated that avoidance motivation, but not approach motivation, was related to problematic alcohol use in their college student sample. These authors suggest that *both* approach and avoidance motivation may mediate alcohol consumption among older problem drinkers, who have a longer, more involved history of alcohol-related reward and punishment. (Ostafin, Palfai, & Wechsler 2003; Palfai & Ostafin, 2003).

In general, based upon our two-dimensional model of cue reactivity, we propose that whenever "craving" or "urge to use" has been measured in the absence of a separate avoidance measure, the resultant index has always inadvertently been a combination of the respondents' approach and avoidance motivation. Obviously, if this

has been the case, the confounding of approach and avoidance motivation has significantly detracted from the utility of information gleaned from these studies.

In order to address the potential for simultaneous or rapidly serial activation of approach and avoidance inclinations in response to substance cues, we recently developed a methodology that allowed us to conduct a preliminary investigation of this phenomenon among college students (Stritzke, et. al., 2004). Participants in this study, who, as a whole, evinced patterns of substance use typical of this population, were exposed to a series of visual images depicting drug cues (alcoholic beverages and tobacco cigarettes), and comparison cues (non-alcoholic beverages and food items). Participants reported their levels of approach and avoidance inclination in response to each cue by indicating "how much they wanted to consume the item" and "how much they wanted to avoid consuming the item" on separate 9-point Likert scales. (During data analysis, responses for each dimension were aggregated across all the items in each of the four categories.) Respondents also rated the subjective level of arousal or excitement they felt while viewing each cue, using a 9-point bi-directional scale with anchors of "completely calm" and "completely aroused" and a "neutral" midpoint. Following the cue exposure session, participants responded to a series of individual difference measures related to their history of alcohol and cigarette use.

Two objectives were accomplished in this preliminary study. First, using an *arousal control design* (Robbins & Ehrman, 1992), we compared participants' arousal to drug cues to their arousal to comparisons cues, and demonstrated that the differences in participants' reactivity to substance-related cues were not due to between-group differences in general arousability. This finding provided validation of our methodology. Secondly, results of this investigation showed that participants' self-reported approach and avoidance reactivity patterns to the visual alcohol and cigarette cues varied systematically based on key aspects of their past and current experiences with these substances. Additionally, the findings supported the utility of measuring avoidance inclination separately from approach inclination, by demonstrating that subgroups separated into clinically significant categories showed similar levels of approach inclination, but were differentiated by their level of avoidance inclination (e.g., smokers trying to quit smoking showed high approach and high avoidance to cigarette cues, while smokers *not* trying to quit smoking showed high approach and low avoidance; see Stritzke, et., al., 2004). Finally, results of regression analyses showed that, for both alcohol and cigarettes, the avoidance dimension captured additional variance beyond the approach dimension, improving the strength of the relationships between participants' cue reactivity and current and historical substance use-relevant variables.

Based on these results, we concluded that approach and avoidance reactivity are independent response dimensions that develop as a function of individuals' specific experiences with a given a substance. Furthermore, the joint analysis of these dimensions appeared to yield more information about individuals' current attitudes toward use of a substance than either dimension could provide alone. The next step in evaluating this methodology was to apply it to a clinical sample of substance abusers.

In developing the present study, we chose incarcerated women as our target population because previous studies examining the characteristics of these women indicate that this population contains a high concentration of substance abusers. Furthermore, the substance abuse evinced by members of this population tends to be

severe and chronic, and complicated by a host of pre- and co-morbid psychological and social problems (Langan & Pelissier, 2001; Peters, Strozier, Murrin, & Kearns, 1997; Williams, 2001; McClellan, Farabee, & Crouch, 1997; Pelissier, Camp, Gaes, Saylor, & Rhodes, 2003). Based on this information, we speculated that the substance abusers in this population would have experienced a significant history of reinforcement and punishment as a result of their drug use, and therefore should have developed substantial approach and avoidance reactivity to drug cues. We expected that a significant portion of these individuals would show ambivalence toward the drugs they have abused. Furthermore, despite the severity and complexity of their substance abuse, this population has yet to be included in any study of substance cue reactivity. In the following sections, we describe the characteristics of this sample in more detail, and comment upon the parameters of the prison environment that may impact upon substance cue reactivity.

Before moving on, however, it should be noted that women prisoners are but one of many populations of substances abusers to which application of this methodology would likely yield useful information. This group was chosen in part because of the interests of the primary investigator, who has had substantial prior clinical experience with this population. In practical terms, this previous clinical interaction has served to increase accessibility to the inmates housed within the correctional institution where the study will be conducted. From a broader perspective, the present study represents another step in a series of empirical efforts designed to increase the base of knowledge about incarcerated women substance abusers, in order to improve the clinical interventions offered to them during their incarceration.

Characteristics of Incarcerated Women in Treatment for Substance Abuse

Many of the incarcerated women surveyed in the studies conducted by Peters and colleagues (1997), Langan and Pelissier (2001), Williams (2001), and McClellan, Farabee, & Crouch (1997) reported frequent and chronic pre-incarceration substance abuse, including the use of “hard” drugs such as crack cocaine and heroin, often in addition to the use of “soft” drugs (i.e., marijuana and / or alcohol) on a daily basis. Furthermore, these women implicated escape from emotional or physical pain as the primary motivation to engage in substance use, rather than purely hedonistic motivations such as sensation or pleasure seeking. The frequent relief-motivated use of powerfully addictive drugs reported by this population connotes a pattern of severe substance abuse.

In addition to severity of abuse, this population showed a particular pattern of pre- or co-morbid psychological problems and social characteristics. These women tended to show lifetime symptoms of depression and other psychological problems, were likely to have been physically and/or sexually abused during childhood or adulthood, and were likely to have been unemployed or financially unstable prior to their incarceration. They were also likely to have been the primary caretaker of children before imprisonment, and typically expected to reassume such a role upon release (Williams, 2001; McClellan, Farabee, & Crouch, 1997; Langan & Pelissier, 2001).

Analysis of these characteristics, collectively, suggests that incarcerated women with substance use disorders are exceptionally likely to exhibit intense, co-existing inclinations to use substances *and* inclinations to resist drug use. Motivation to use drugs is reflective of their desire for positive and negative reinforcement (i.e., for pleasurable drug effects and to escape from painful emotions and circumstances), whereas motivation to avoid further drug use arises from recognition of the punishing effects their drug use has upon them and their children or other loved ones. Arguably, by the time the circumstances of their lives have deteriorated to the point of incarceration, these substance abusing women are likely to have developed intense ambivalence regarding their substance use. In the present study, we attempted to measure independently both the approach and the avoidance reactivity components of this ambivalence using a visual cue exposure methodology.

Multidimensional Cue Reactivity and Parameters of the Prison Environment

Our literature review indicated that, to date, no substance cue reactivity studies have been conducted within a prison setting. Thus, one main aim of the present study was to determine whether our particular substance cue reactivity methodology would function effectively in this unique context, eliciting reliable approach, avoidance, and arousal reactivity patterns that are meaningfully linked to participants' substance use histories and related individual differences. In this connection, it is important to reiterate that the present study also represented the first attempt to measure these three reactivity dimensions within *any* clinical sample of persons with substance use disorders.

Although theory and our preliminary data provide a strong basis for predictions about the patterns of reactivity that a clinical sample of substance abusers might exhibit, it could be critically important to consider how characteristics of a treatment program within a federal prison environment might influence participants' reactivity patterns. The controlled environment of a prison is a unique setting, differing along several key dimensions from other drug treatment contexts in which cue reactivity studies have been conducted. We identified three specific aspects of the prison context that may have a significant impact on inmates' overall substance cue-elicited response patterns. We attempted to incorporate direct tests of relevant predictions into the study design where possible, and, when direct measurement was not possible, to make evidence-based a priori assumptions about participants' perceptions of these factors for use in interpreting the reactivity data obtained in this investigation.

The first area in which the prison context could impact our measurement of substance cue reactivity is related to the potential contamination of the participant sample due to secondary gain associated with participation in the Residential Drug Abuse Program (RDAP). As an incentive to encourage substance abusers to enter treatment while incarcerated, the Federal Bureau of Prisons instituted a policy allowing successful RDAP completers to receive up to a six to twelve month reduction in their sentences. Thus, the possibility exists that inmates may intentionally exaggerate or even fabricate aspects of their substance use histories in order to gain admission to the

treatment program and become eligible for a sentence reduction. The validity of the diagnostic information gathered in the RDAP eligibility interview was considered of critical importance because we intended to use this information to form our recent substance use history groupings.

To address the validity of the diagnostic information used in the present study, we collected a range of substance use related information by having participants complete a number of self-report questionnaires known to be related to drug use history (the specific measures are described in detail in the next section). The confidentiality of this information was emphasized to participants at the time that they responded to the measures. We were then able to compare participants' responses on these measures across the different levels of the recent substance use history grouping variables. The extent to which the levels differed in the expected directions provided an assessment of the validity of the recent drug use history groupings.

A second way in which the prison setting might influence substance cue reactivity has to do with the punishment associated with substance use. It is likely that drug and / or alcohol use may have contributed directly or indirectly to incarceration for many of the participants in the present study. Additionally, inmates are made well aware of the severe penalties the prison imposes for use of drugs or alcohol within the prison. Therefore, the participants are quite literally surrounded by drug punishment cues, which could serve to enhance the avoidance reactivity elicited by the drug cues presented during the study. Astin (1962) speculated that proximity to reward cues combined with distance from punishment cues contributes to repeated relapse to substance abuse despite efforts to abstain from use. The prison environment represents the opposite orientation; that is, proximity to punishment cues and distance from reward cues. Although there is no way to manipulate this setting-related factor, it is likely that it will not impact reactivity to cigarette cues (which are permitted in the prison, and which are rarely a contributing factor in the commission of crimes). Thus, it will be possible to observe differences in reactivity patterns to cigarettes and the other three drugs, which may help to evaluate the impact of this aspect of the prison environment.

The third aspect of the prison setting that may have a significant impact on inmates' overall substance cue-elicited response patterns is fact that the prison environment is controlled in such a way as to significantly limit inmates' access to psychoactive substances. Of course, this is not to say that drugs and alcohol are necessarily entirely absent from prison compounds, but rather to point out that the substance-related institutional controls (e.g., prohibition of alcohol and drugs, control of incoming materials, searches for contraband, random urine and breath analysis for the presence of drugs and alcohol) might combine to significantly decrease inmates' *perceptions* of the availability of drugs and alcohol, relative to the perceptions of participants in cue reactivity studies conducted in other types of settings.

This is important because perceptions regarding the availability of a substance have been shown to have a substantial impact upon users' reactivity to cues related to that particular substance (Davidson, Tiffany, Johnston, Flury, & Li, 2003). A recent review of cue reactivity studies that measured and / or manipulated participants' perception of the availability of substances showed that individuals who believe that they will have an immediate opportunity to consume the cued substance typically report

higher inclinations to use the substance (i.e., approach inclination), relative to those who do not perceive an imminent opportunity to use (Wertz & Sayette, 2001).

Under our two-dimensional concept of substance cue reactivity, this finding can be interpreted in two ways. First, it is possible that perceived unavailability of a particular substance may *directly* diminish the strength of participants' approach inclination toward that substance (which appears to be the conclusion that investigators of this phenomenon have collectively drawn). However, a second interpretation is also plausible. That is, because these investigators did not measure the two other reactivity components that will be measured in the present study (i.e., avoidance inclination and arousal), it is possible that the dampened approach reactivity seen in previous studies may actually be a function of *heightened avoidance reactivity, decreased arousal response, or a combination of both.* As mentioned above, when only approach is directly measured, participants may inadvertently collapse other reactivity components into their self-assessment of approach inclination, thereby artificially dampening the approach response. Thus, one possibility is that participants in the proposed study may show dampened approach reactivity to cues representing substances they perceive to be unavailable (consonant with interpretations of previous studies). Alternatively, it is possible that they may show the higher levels of approach typically seen among individuals who perceive the substance to be available, coupled with relatively high levels of avoidance and / or lowered levels of arousal.

In attempting a direct test of the effect of perceived substance use opportunity upon cue reactivity, we had planned to ask participants to rate the degree to which they perceived cigarettes, alcohol, marijuana, and crack cocaine to be available in their current environment. However, we were not permitted to do so, because the guidelines governing research in federal prisons prohibit asking inmates to report about present or future illegal activities. In the absence of directly assessing inmates' perceptions of drug availability, we attempted instead to manipulate the perceived availability of cigarettes, by employing a modification of a manipulation recently tested by Wertze and Sayette (2001).

Specifically, at the beginning of the first experimental session, half of the groups of participants were informed that current cigarette smokers would have an opportunity to smoke during the regularly scheduled opening of the compound for inmate movement, a time in which smoking is allowed in designated areas outdoors. The other half of the groups were informed that they would NOT be allowed to smoke during the break. During the *second* experimental session, these groups were reversed, such that those permitted to smoke during the first session were prohibited from smoking during the second session, and those that were prohibited from smoking during the first session were permitted to smoke during the second session. We hoped that this would provide the opportunity to perform a direct within-subjects comparison of smokers' reactivity to cigarette cues under "available" vs. "unavailable" conditions, which could then be used to provide some assistance in interpretation of participants' reactivity to cues related to the substances whose availability could not be manipulated in the prison context.

In addition to the above-described direct manipulation of cigarette availability, we also used our awareness of the prison conditions to make assumptions about participants' perceptions of the availability of all four of the cued substances. This

enabled us to make some inference about how these perceptions may be affecting participants' reactivity to the substance cues. Cigarettes are permitted in the prison, but the other three psychoactive substances (alcoholic beverages, marijuana, and crack cocaine) are prohibited. Therefore, we assumed that in general, our participants perceived cigarettes to be more available than the other substances.

By collecting substance use-relevant self-report information to assess the validity of the information participants reported in their diagnostic interviews, manipulating the availability of cigarettes between study sessions, and taking into consideration the impact of increased drug punishment cues in the prison environment, we were able to maximize the potential of our methodology to obtain interpretable information about the substance cue reactivity of our sample of incarcerated women substance users. In the following section, we describe in detail the substance-use related individual differences that were used to assess the characteristics of our participants.

Substance-Related Individual Differences

In selecting substance-related individual difference measures for the present study, we took direction from current theories regarding the genesis and maintenance of substance use disorders, from our preliminary studies of substance cue reactivity in college students, and from the extant body of substance cue reactivity literature. In addition to our main purpose of examining the characteristics of our sample, we also sought to include measures that might be related to participants' reactivity to the substance cues.

The diagnostic eligibility interview referenced in the above section obtained diagnoses of participants' substance use disorders in the year prior to the arrest resulting in their current incarceration. For comparison purposes, we included in the self-report measures a questionnaire that requires participants to report about their use of the four substances represented in the cue exposure task, and also their use of a range of other commonly abused substances. We expected that participants with similarities in substance use history would exhibit similar reactivity patterns to the four sets of psychoactive substance cues.

To further assess the extent of participants' involvement with the four substances under investigation in the present study, we selected measures of three constructs known to be related to substance abuse: motivation for changing substance use, craving for substances, and motives for using substances. Instruments assessing these constructs have previously been developed for each of the four substances targeted in the present study (except for motives for crack cocaine use; however, an instrument designed to measure cocaine addicts' expectations about cocaine effects was included as a reasonable proxy). As such, these instruments can be used to compare and differentiate groups of individuals with differing levels of recent involvement with the substances.

Based on our previous study and other studies of cue reactivity, we expected that these three constructs would be related to participants' approach and avoidance reactivity to the four drug cues in the present study. In general, research has shown

that certain aspects of an individual's current *global or generalized disposition* toward a particular substance are related to that person's *immediate or momentary response* to a cue specific to that substance (e.g., Cox, & Klinger; 1988; Conklin &Tiffany, 2001; Madden & Zwaan, 2001; Fromme, Stroot, & Kaplan, 1993; Tiffany & Drobes, 1991). We regard the relationship between general disposition toward a substance and momentary reactivity to a specific substance cue as similar to the relationship between a person's current mood and his or her momentary response to an emotionally evocative cue (Davis & Lang, 2003; Bradley, Codispoti, Cuthbert, & Lang, 2001). Also analogous is the relationship between trait characteristics (e.g., hostility or anxiety) and state responses to immediate situations or stimuli (e.g., anger or state anxiety) (Spielberger, 1985; Spielberger, Sydeman, Owen, & Marsh, 1999). Essentially, one's general disposition constitutes the contextual background in which the immediate response takes place. As such, there should be some predictive relationship between these three measures of global dispositions and cue-elicited reactivity.

For exploratory analyses, we also included other measures of current disposition toward the four substances under investigation in the current study. Among these are measures of participants' expectancies regarding the effects of the substances, and measures of substance-specific self-efficacy and situational confidence. For alcohol, we also included two measures of lifetime drinking-related problems. In addition, we included two measures of personality traits that might be related to substance cue reactivity.

Main Objectives of the Study

The purpose of the present study was to test the ability of our newly modified cue exposure methodology to gather meaningful information about the substance cue reactivity of women substance abusers during incarceration. As described above, this study simultaneously extended the methodology to a clinical population *and* a novel context, and also added two new psychoactive substances, marijuana and crack cocaine, to the categories subjected to evaluation.

We presented photographic cues depicting cigarettes, alcoholic beverages, marijuana, crack cocaine, food, and non-alcoholic beverages to women prison inmates with diagnosed substance use disorders. Participants reported their momentary arousal, approach, and avoidance reactions to each image. They then responded to a series of self-report instruments that assess current and historical aspects of substance use and several personality characteristics that may be related to substance use. Using this information, we attempted to accomplish the two specific aims of this investigation: 1) to further establish the reliability and validity of the methodology, including the utility of the visual substance cues, and the viability of the approach and avoidance response dimensions, and, 2) to obtain information about the substance cue reactivity of an understudied population of substance abusers, women inmates.

The following hypotheses were tested in connection with the above-stated specific aims:

1. We predicted that when participants were grouped according to their recent use of cigarettes, alcohol, marijuana, and crack cocaine, clinically meaningful differences across the levels of these variables would emerge on self-report measures known to be related to substance use disorders.

2. We predicted that each of our four drug cue sets and four comparison cue sets would demonstrate content validity and reliability.

3. We predicted that each of our four drug cue sets would demonstrate specificity; that is, that each drug cue set would elicit differential arousal reactivity among participants when participants were grouped according to their recent use of that particular drug. Arousal to drug cues was predicted to increase as a function of the intensity of participants' level of recent involvement with each substance. To test the specificity of our four cue sets, we grouped participants based on their recent use of each of the four drugs, and then compared participants' arousal ratings for each of the four drug cue sets to their arousal ratings for the four comparison cue sets. In an even more stringent test of specificity, we grouped participants based on their recent use of each of the four drugs, and then compared participants' arousal ratings to the matched drug to their arousal ratings to the three non-matched drugs.

4. We predicted that approach and avoidance ratings would be found to represent distinct reactivity dimensions, and further, that both approach and avoidance reactivity to the four drug cue sets would vary as a function of participants' recent use of each of the four drugs. To test these predictions, we examined approach and avoidance reactivity in the following three ways:

a. We placed approach and avoidance ratings on orthogonal axes and examined the resultant reactivity patterns of the full sample to each of the four drug cue sets and each of the four comparison cue sets. We predicted that for each of the four drugs, each quadrant of 'reactivity space' would be populated by some members of our sample.

b. We grouped participants according to their recent use of each of the four drugs, and then sought to answer the following three questions for approach ratings, and then for avoidance ratings:

1) Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to non-drug comparison cues?

2) When participants are grouped according to recent use of a specific drug, how does reactivity to cues for that drug relate to reactivity to non-drug comparison cues?

3) Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to cues for other drugs?

c. We grouped participants according to their recent use of each of the four drugs, and then examined the cross tabulation between recent drug use and reactivity space for each drug. We predicted that non-users would primarily fall into the Indifferent and Avoidant quadrants, while non-problem and problem users would fall into the Approach, Avoidant, and Ambivalent quadrants, depending on their current motivational state toward each drug.

5. We predicted that, for each of the four drugs, participants' approach ratings and avoidance ratings would each contribute unique variance in the prediction of participants' scores on the self-report measures known to be related to substance use disorders.

6. We predicted that cigarette smokers' arousal and avoidance reactivity would be significantly lower in the "Smoking Permitted" cue exposure and rating session that in the "Smoking Not Permitted" cue exposure and rating session. We predicted that approach ratings would not differ between the two sessions.

METHOD

Participants

Participants in this study were 155 women inmates incarcerated in the Federal Correctional Institution (FCI) located in Tallahassee, Florida. Prior to participation in the study, all participants were determined to be eligible for admission into the prison's nine-month Residential Drug Abuse Program (RDAP). Eligibility for RDAP was based upon diagnosis of one or more substance use disorders, which were obtained from a structured clinical interview conducted by one of FCI Tallahassee's Drug Treatment Specialists. One hundred and seventeen of the participants were recruited from RDAP groups in progress, while the remaining thirty-nine were recruited from the RDAP waiting list. Most of the waiting list participants were within a year or less from entering RDAP. Recruitment from the RDAP groups was conducted at various points over the course of approximately 10 months, so that participants' length of time in treatment at the time of participation in the study ranged from one month to eight months.

Materials

Equipment

A Dell laptop computer and a projection unit were used to project the substance cues and instruction slides onto a blank, white Dry-Erase board. Microsoft PowerPoint software was used to control the timing and presentation of the preparatory slides, substance cues, and rating periods.

Slides

Fifty-four substance cue slides were presented to represent six appetitive substance categories: alcoholic beverages (n = 12; 6 beer, 3 wine, and 3 hard liquor), cigarettes (n = 6), marijuana (n = 6), crack cocaine (n = 6), food (n = 12; 6 "healthy", e.g., vegetables and fruit, and 6 "unhealthy", e.g., high fat, high calorie, high refined sugar foods), and non-alcoholic beverages (n = 12; 6 non-caffeinated and 6

caffeinated). Within all categories, individual cues varied by setting (e.g., bar, restaurant, home, neutral background), and activity state (e.g., substance sitting untouched on table, held in hand, or actively consumed).

In choosing images for presentation, brand names and identifying symbols were excluded to the extent possible to minimize potential brand preference biases. In cases where brand identifiers were unavoidably present, more than one brand of the substance was displayed (e.g., a refrigerator cooler containing many different brands of beer). To avoid contamination of reactivity to substance cues with reactions to affective information conveyed by people depicted with the substance, cues were displayed without human involvement whenever possible. When people were depicted along with a substance, facial expressions and body posture were kept neutral.

To eliminate potential order effects, the six cue types were distributed as evenly as possible across three sets of 18 images, and these three image sets were combined to create six different presentation orders. Each of the six orders was presented to a subset of the participants. Within each set of 18 images, cues were arranged in a quasi-random order such that there are never two of any category in a row, and a particular category was not systematically followed by the same other category.

Measures

Substance Cue Reactivity Ratings

"Approach," "Avoidance," and "Arousal" ratings were obtained for each substance cue image presentation. Approach was defined as *wanting to consume* the depicted item. Avoidance was defined as *wanting to avoid consuming* the depicted item. Each of these two dimensions was rated on a 9-point scale with low and high anchors of "not at all" (0) and "very much" (8). Participants were told that the scales should be regarded as independent of one another (Powell et al., 1993), and examples of possible response patterns across the two scales were given as part of the instructions for the rating task. The arousal item was intended to assess the participants' feelings of calmness versus arousal in reacting to the images. A 9-point scale, with "completely calm" (0) and "completely aroused" (8) as the extreme anchors and "neutral" (4) as the midpoint, was used for these ratings (Lang, Bradley, & Cuthbert, 1999). A separate ratings page was provided for each cue, and the order of presentation of rating scales for Approach, Avoidance, and Arousal was counterbalanced across cues.

A fourth item was added to the end of each rating page. This item was always last on the page, and required participants to identify the item they just viewed and rated. Participants were asked to choose from a list the category that best described the item. This list, which was always presented in the same order, offered the following choices: non-alcoholic beverage without caffeine, non-alcoholic beverage with caffeine, alcoholic beverage, tobacco cigarettes, marijuana, cocaine, healthy food, unhealthy

food, and other. Participants were instructed to write in their response if they chose the "other" category. Participants were instructed to give their best guess if they weren't sure, and were also told that some categories were more subjective than others (i.e., the "healthy" and "unhealthy" food categories).

Individual Difference Questionnaires

At the conclusion of the image-rating task, participants were asked to complete a series of individual difference questionnaires related to substance use history and experiences, substance-related attitudes, cognitions, and affect, and personality characteristics.

Substance Use History. Participants were first asked to report about their lifetime substance use via completion of a modified version of the SADU (Schedule of Alcohol and Drug Use; ref). Modifications included: a) the addition of several substances or substance categories expected to be relevant to the present sample, and, b) changing the wording of the items so that the target time frames ("past 30 days" and "past year") refer to participants' substance use *prior to the start of their current incarceration*. This latter modification was made in order to comply with BOP policy that prohibits asking inmates to report about their engagement in behavior that violates institutional regulations, and also so that the "past year" time frame used here would roughly match the time period that participants were asked about in their RDAP eligibility interview. After completing the SADU, all participants were asked to respond to a series of questionnaires related to their personal experience with the four psychoactive substances depicted in the image rating task (alcoholic beverages, tobacco cigarettes, marijuana, and cocaine). In this section, participants also completed an instrument designed to measure the extent to which they believe that their current incarceration is a result of their use of each of the four substances targeted in the study.

Alcohol Questionnaires. In this section, participants were first asked to provide information about their alcohol usage patterns *in the year prior to the start of their current incarceration*, using an expanded and modified version of the standard quantity/frequency/variability instrument of Cahalan, Cisin, & Crossley (1969). This instrument probes average number of drinking occasions per week, average number of alcoholic beverages per drinking occasion, and typical frequency of consumption to intoxication.

The remaining alcohol-related questionnaires asked participants to report about their *current* thoughts and feelings about alcohol, and about their experiences with alcohol across their lifetimes. Participants' current readiness to change their alcohol use was assessed using the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES; Miller & Tonigan, 1996), which is a 19-item scale that measures three treatment-related constructs: recognition of alcohol abuse, ambivalence over alcohol use, and current attempts to change alcohol use. The SOCRATES includes items such as: "Sometimes I wonder if I am an alcoholic", and "I am working hard to change my drinking". Items are rated on a 5-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (4) as anchors.

To assess alcohol craving, we included the Alcohol Abuse Self-Efficacy – Temptation, and the Alcohol Abuse Self-Efficacy - Confidence questionnaires. These

are two instruments that provide an index of participants' relative levels of temptation to consume alcoholic beverages, and an index of participants' confidence in their ability to resist alcohol cravings, in specifically described high risk for alcohol relapse situations (AASE-T, AASE-C; DiClemente, Carbonari, Montgomery, & Hughes, 1994). Participants are asked to rate how tempted they would be to drink, and how confident they are that they would not drink in situations such as: "When I am feeling depressed", and "When people I used to drink with encourage me to drink." Items are rated on a 5-point Likert scale with "Not at all tempted (confident)" (0) and "Very tempted (confident)" (4) as anchors.

History of lifetime alcohol-related problems was assessed using the CAGE (Ewing, 1984) and the Short Michigan Alcohol Screening Test (SMAST, Selzer, 1971). The CAGE is a four-item instrument that measures the presence or absence of four common indices of alcohol abuse (for example, "Have people annoyed you by criticizing your drinking?"). The 13-item SMAST measures negative consequences of drinking, self and others' concern about drinking, and lack of control over drinking and/or behavior while intoxicated. For both the CAGE and the S-MAST, items are responded to using "No" (0) or "Yes" (1). Participants also completed the F-MAST and the M-MAST, which are versions of the MAST that assess parental alcohol abuse.

Motives for alcohol use was assessed using the Drinking Motives Questionnaire (DMQ; Cooper, Russell, Skinner, & Windle, 1992), a 20-item instrument that measures four distinct motivations to use alcohol: to enhance social experiences, to relieve negative affect, to increase positive affect, and in response to peer pressure to use alcohol.

The Alcohol Approach and Avoidance Questionnaire (AAAQ; Stritzke) is a 21-item instrument designed to measure participants' inclinations to seek and consume alcohol (e.g., "craving"), and their inclinations to avoid and refrain from consuming alcohol, over the past 30-day time period. The AAAQ contains items such as: "I wanted to have a drink or two" and "I was thinking about the benefits of being sober." Items are rated on a 9-point Likert scale with "Not at all" (0) and "Very much" (8) as anchors.

The Temptation and Restraint Inventory (TRI; Collins & Lapp, 1992) is a 15-item questionnaire containing two subscales that measure cognitive preoccupation with drinking, and level of effort exerted to control drinking behavior. The TRI contains items such as "At times, do you find yourself unable to stop thinking about drinking", and, "How often do you attempt to cut down on the amount you drink". Items are rated on a 9-point Likert scale with "Never" (0) and "Always" (8) as anchors.

Positive and negative alcohol-related expectancies were assessed using the Alcohol Expectancy Inventory (AEI; ref), which is a 24-item instrument that measures participants' beliefs about the positive and negative physical and psychological effects of alcohol. The AEI consists of a series of words describing subjective states and characteristics (e.g., "Tired", "Arrogant") that fill in the stem "Alcohol makes me ____". Participants rate the extent to which they believe that drinking alcohol would produce these effects, using a 7-level rating scale that ranges from "Never" (0) to "Always" (6). An additional instrument measuring alcohol expectancies, the Comprehensive Effects of Alcohol (CEOA; Fromme, Stroot, & Kaplan, 1993) was also completed, because this instrument includes assessment of more distal positive and negative alcohol use consequences.

Cigarette Questionnaires. In this section, participants were asked to report about their current and past cigarette smoking patterns, current cigarette craving, motives for smoking cigarettes, and current stage of change regarding cigarette smoking. (Because smoking is permitted at FCI Tallahassee in certain areas at specified times, BOP research standards permit querying inmates about current use of cigarettes as well as past use.) Using a series of items developed for the present study, participants categorized themselves as Non-smokers, 5 or fewer cigarettes per day Smokers, 10 cigarettes per day Smokers, or 20 or more cigarettes per day Smokers, and also described their lifetime smoking in terms of quantity and frequency and quit attempts. The Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was used to determine level of nicotine dependence.

Participants' current readiness to change their cigarette smoking was assessed using the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES – 8C; Miller & Tonigan, 1996), which is a 19-item scale that measures three treatment-related constructs: recognition of problematic smoking, ambivalence about smoking, and current attempts to change smoking behavior. The SOCRATES includes items such as: "Sometimes I wonder if I am addicted to cigarettes", and "I am working hard to change my smoking". Items are rated on a 5-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (4) as anchors. An additional item related to stages of change was added, in which participants were asked to categorize their current smoking behavior into one of the five stages of change: precontemplation (not planning to quit at this time), contemplation (currently smoking, but planning to quit), action (currently making an effort to quit), maintenance (have quit smoking and maintaining abstinence), and relapse (had quit smoking, but have since resumed smoking).

Current craving for cigarettes was assessed using the Questionnaire for Smoking Urges (QSU; Tiffany & Drobes, 1991), a 26-item instrument that includes items such as: "If I were offered a cigarette, I would smoke it immediately". Items are rated on a 7-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (6) as anchors. The QSU yields a total smoking urge index that reflects mild intentions and desires to smoke, anticipation of pleasure or relief from negative affect and nicotine withdrawal, and urgent and overwhelming desires to smoke.

Motives for cigarette smoking were assessed using a modification of the Drinking Motives Questionnaire (DMQ; Cooper, Russell, Skinner, & Windle, 1992), in which the items have been changed to refer to cigarette smoking. The resulting Smoking Motives Questionnaire (SMQ) is a 20-item instrument that measures four distinct motivations to smoke cigarettes: to enhance social experiences, to relieve negative affect, to increase positive affect, and in response to peer pressure to smoke.

Smoking self-efficacy was measured using the Smoking Self Efficacy Questionnaire (SEQ-12; Etter, Bergman, Humair, & Pergener, 2000). This 12-item instrument assesses respondents' confidence in their ability to refrain from smoking in various situations.

Expectancies about the effects of cigarette smoking were assessed using the Smoking Consequences Questionnaire – Adult version (SCQ-A; Copeland, Brandon, & Quinn,1995). This is a 55-item instrument that assesses smokers' expectations of the positive and negative effects of cigarette use.

Marijuana Questionnaires. In this section, participants were first asked to provide information about their marijuana usage patterns, including quantity and frequency of use, in the year prior to the start of their current incarceration. They were then asked to describe their current readiness to change their marijuana use via completion of the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES – 8D; Miller & Tonigan, 1996). This 19-item scale measures three treatment-related constructs: recognition of marijuana abuse, ambivalence about marijuana use, and current attempts to change marijuana use. The SOCRATES includes items such as: "Sometimes I wonder if I am addicted to marijuana", and "I am working hard to change my marijuana use". Items are rated on a 5-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (4) as anchors.

Current craving for marijuana was assessed using the Marijuana Craving Questionnaire (MCQ; Heishman, Singleton, & Ligouri, 2001), a 45-item instrument that includes items such as: "I don't want to use marijuana right now", and "Using marijuana would make me feel less depressed". Items are rated on a 7-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (6) as anchors.

Motives for marijuana use were assessed using the Marijuana Motives Questionnaire (MMQ; Simons, Correia, Carey, & Borsari, 1998). The MMQ is a 25-item instrument that measures five distinct motivations to smoke marijuana: to enhance social experiences, to relieve negative affect, to increase positive affect, in response to peer pressure to smoke, and to alter or expand perception.

Expectancies about the effects of marijuana were measured using the Marijuana Effects Expectancy Questionnaire (MEEQ; Schafer & Brown, 1991), a 71-item instrument that measures current beliefs about the physical and psychological effects of marijuana. The MEEQ contains items such as: "Marijuana gives me a mellow feeling", and "Marijuana makes me paranoid".

Cocaine Questionnaires. In this section, participants were first asked to provide information about their cocaine usage patterns, including quantity and frequency of use, in the year prior to the start of their current incarceration. They were then asked to describe their current readiness to change their cocaine use via completion of the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES – 8D; Miller & Tonigan, 1996). This 19-item scale measures three treatment-related constructs: recognition of cocaine abuse, ambivalence about cocaine use, and current attempts to change cocaine use. The SOCRATES includes items such as: "Sometimes I wonder if I am addicted to cocaine", and "I am working hard to change my cocaine use". Items are rated on a 5-point Likert scale with "Strongly disagree" (0) and "Strongly agree" (4) as anchors.

Current craving for cocaine was assessed using the Cocaine Craving Questionnaire (CCQ;Tiffany, Singleton, Haertzen, & Henningfield, 1993), a 45-item instrument that includes items such as: "I don't want to use cocaine right now", and "Using cocaine would make me feel less depressed". Items are rated on a 7-point Likert scale with "Strongly agree" (0) and "Strongly disagree" (6) as anchors.

Expectancies about the effects of cocaine were measured using the Cocaine Expectancies Questionnaire – Patient version (CEQ-P, Rohsenow, Sirota, Martin, & Monti, 2003), a 33-item instrument that measures respondents' current beliefs about the physical and psychological effects of cocaine. The CEQ-P was developed specifically

for use with patients in treatment for cocaine abuse, and contains items such as: “I feel happier when I use cocaine”, and “I feel more paranoid when I am using cocaine”.

Personality Questionnaires. In this section, participants were asked to complete two measures of personality, the BIS/BAS Scales (Carver & White, 1994), and the Psychological Inventory of Criminal Thinking Styles (PICTS; Walters, 2002). The BIS/BAS Scales are 20 items that measure four dimensions of behavioral inhibition and behavioral activation, based upon Gray’s (1987) theory of the motivational systems that underlie behavior. The BIS/BAS Scales measure Behavioral Inhibition System (BIS), and three separate aspects of the Behavioral Activation System (BAS): Reward Responsiveness, BAS Drive, and BAS Fun Seeking. The PICTS is an 80-item instrument that measures eight subtypes of criminal thinking: mollification, cutoff, entitlement, power orientation, sentimentality, superoptimism, cognitive indolence, and discontinuity.

Procedure

As described above, participants in this study were recruited from the RDAP treatment groups and treatment waiting list. For participants currently in RDAP treatment groups, recruitment was conducted by the researcher during a 15 to 20 minute presentation that took place at the beginning of a treatment group session. For participants on the RDAP waiting list, recruitment was conducted by summoning prospective participants in groups of 5 to 10 to a half-hour recruitment session via the prison’s “call out” system, which renders a daily list of appointments for all inmates that is posted in the facility housing units each day. During the recruitment presentations, prospective participants were told that the purpose of the study is to examine people’s responses to pictures associated with common habits, such as drinking, smoking, eating, and drug using. They were told that their participation is voluntary, and that the study would require them to complete two tasks over three sessions: a) an image rating task, in which they would view and rate pictures of commonly consumed items such as food, beverages, and drugs, and b) a self-report task, in which they would complete a series of questionnaires relating to their behavior and attitudes. Potential recruits were informed that they would be given one Krispy Kreme Original Glazed® doughnut at each session, as a token of appreciation for their participation.

A maximum of 15 participants attended each experimental session, which were held in one of the four group therapy rooms located in the FCI Tallahassee RDAP unit (F-Unit). Typically, treatment group cohorts participated in the sessions as a group, during regularly scheduled group meeting times. Group-members who chose not to participate in the study were given an alternate assignment to complete in a different location. Study participants from the RDAP waiting list attended experimental sessions in one of the RDAP group therapy rooms; all of these sessions took place on Fridays because the RDAP treatment groups use the therapy rooms Monday through Thursday.

All participants attended three sessions of approximately equal length (2.5 hours). Sessions generally occurred one week apart. Session 1 and Session 2 always began with the cue presentation and rating task, which took approximately 1.25 hours to

complete. Participants were then given a 15-minute break, after which they returned to the session to work on the self-report questionnaires. During the third session, participants completed the remaining questionnaires.

Prior to the start of each task, a scripted set of instructions was read aloud by the researcher, in order to ensure that every cohort of participants received the same instructions (see Appendix A). During the instructions, participants were reminded that their responses would be kept confidential, that there were no right or wrong answers for either task, and they were encouraged to provide honest and accurate responses.

During Session One, approximately half of the cohorts were assigned to the Told No Smoking (No Smoke) condition, while the others were assigned to the Permitted to Smoke (Smoke) condition. Each group was assigned by the experimenter to one of these two conditions prior to the start of the first session. The scripted instructions informed participants in the No Smoke condition that they would not be allowed to go outside to smoke at the break (9:30am for the morning sessions, and 2:30pm for the afternoon sessions). Participants in the Smoke condition were informed that they would be allowed to go outside to smoke at the break.

During Session Two, the smoking conditions were reversed, such that groups that were in the No Smoke condition in Session One were in the Smoke condition in Session Two. Groups who were permitted to smoke during Session One were prohibited from smoking during Session Two. All groups were permitted to smoke on the break during Session Three.

At the start of Session One and Session Two, participants were given the materials needed to complete the image-rating task (three ratings packets, numbered 1 to 18, 19 to 36, and 37 to 54, and a pencil). After distributing these materials, the experimenter read the standardized instructions describing the cue presentation and rating procedure and provided an opportunity for participants to ask questions about the task.

Once the participants were familiar with the rating procedure, the cue presentation and rating task began. Participants were instructed to refrain from commenting about the images and/or their ratings during the procedure to avoid the possibility of biasing others' ratings. Participants viewed and rated all 54 images, in one of the six pre-determined orders described above. Each image rating trial began with a 5 s presentation of a preparatory slide that served to focus participants' attention on the screen. Each preparatory slide was followed by a Substance cue image, which was presented for 6 s, and was followed by a 45 s rating / relaxation period. Based on findings from pilot studies of the present protocol and previous studies using a similar procedure, it was expected that participants would generally finish their ratings within 30 s, leaving a relaxation period of about 15 s for them to clear their minds before the next preparatory slide signaled the conclusion of the current rating period.

When the cue presentation and rating task was complete, participants were given a 15-minute break. The Smoke sessions were planned so that the break time coincided with a period of permitted inmate movement on the prison compound, so that participants were able to go outside to smoke in the designated smoking area if they chose to do so. Also during the break, participants were allowed to relax, use the restroom, or go to their rooms. The No Smoke sessions were timed so that the break occurred when the compound was closed to inmate movement. Following the break,

participants returned to their seats and were given their doughnuts prior to beginning the second task, the self-report questionnaires.

Participants were given a binder containing half of all of the self-report questionnaires described above. Roughly half of the participants received the binder containing questionnaires related to lifetime substance use history, alcohol and marijuana during Session One, while the other half received the binder containing cocaine-related questionnaires and personality measures. All participants received the opposite binder during Session Two. Because of the cigarette availability manipulation, the questionnaires related to cigarette smoking were included in both binders, and participants were instructed to complete these first at both sessions. The binders also contained numbered sets of answer sheets that were labeled to match the questionnaires. Before participants started filling out the questionnaires, the experimenter read the standardized instructions for this task aloud to the participants, emphasizing the need to pay attention to the differing time frames among the questionnaires (e.g., "past 30 days", "past year prior to the start of the present incarceration"). Participants were reminded to read the instructions for each questionnaire carefully before they begin responding to the items.

At Session Three, participants were given the two binders containing the questionnaires and their answer sheets, and reminded of the instructions for the task. The total time to complete the questionnaires during Session Three varied among participants; as such, participants were given their doughnuts and dismissed whenever they completed both sets of questionnaires. All participants were able to finish by the end of the third session.

Given the potential of the substance cues to elicit emotional reactivity, and the sensitive nature of the self-report battery, it was considered possible that some participants would experience a degree of psychological distress. Therefore, all participants were given the opportunity to ask questions and air concerns during a debriefing period at the end of each data collection session. Participants were also reminded at the beginning of each session that they could choose to end their participation at any time, with no penalty. Many participants had comments and / or questions about the cue presentation task. Questions were answered immediately, or were deferred to the third session when the answer was directly related to the study objectives. Only one participant experienced a negative reaction to the initial cue presentation task that was sufficient to cause her to drop out of the study. This participant was immediately referred to her group leader for additional debriefing after the extent of her distress was assessed by the researcher.

All participants were assigned an experimental code number to protect the confidentiality of their responses, and their names were not recorded on any of the experimental materials. The researcher kept a master list that identifies the experimental code number of each participant for the duration of the data collection period, so that background information obtained from RDAP records and the BOP national database could be added to inmates' questionnaire responses. This master list was destroyed upon completion of the data collection phase of the study.

RESULTS

Sample Demographics and Formation of Recent Drug Use History Between-Subjects Grouping Variables

One hundred and fifty-five women participated in the study. Participants ranged in age from 21 to 64 years old, with a mean age of 35.11 years old at time of participation. Ninety-three of the participants were Caucasian, 55 were African American, and the race of seven participants was unknown due to missing data. With respect to educational history, 102 participants had either completed high school or obtained a GED (Graduate Equivalency Diploma) prior to participating in the study. Twenty-one participants were enrolled in GED preparation classes at the time of their participation; 14 participants were enrolled in pre-GED preparation classes, and 6 participants were enrolled in GED classes for persons with special learning needs. The educational status of 12 participants was unknown due to missing data. It should be noted that because RDAP is a Cognitive Behavior Therapy based program, participants must possess sufficient cognitive ability to effectively manage the material presented throughout the 9-month program.

Examination of the participants' current offenses indicated that 102 participants were currently incarcerated on drug possession or trafficking convictions. Of those, 49 participants had committed offenses related to cocaine, 29 participants had committed offenses related to methamphetamine, and 11 had committed offenses related to marijuana. Fifty-three participants were incarcerated for crimes other than drug offenses, although it should be noted that many of these offenses may have been committed in support of a drug habit (e.g., fraud, robbery, burglary, embezzlement), or as the result of association with a drug-related crime organization (e.g., money laundering, racketeering). The sentence lengths for participants ranged from 18 to 324 months, with a mean of 49.7 months.

One of the main goals of the present study was to demonstrate that participants' reactivity to each of the four sets of psychoactive substance cues is specifically determined by their recent history of using each of the substances. In order to assess the impact of substance use history on reactivity to substance cues, participants were grouped according to their recent use pattern for each of the four drugs represented in the substance cue sets, cigarettes, alcoholic beverages, marijuana, and crack cocaine.

Cigarette smoking is allowed at FCI Tallahassee, therefore participants were grouped based on their current use of cigarettes at the time they participated in the

study: “O” = Non-Smokers (n=30), “5” = Smokers who reported smoking 5 cigarettes or less each day in the past 30 days (n=24), 10 = Smokers who reported smoking about 10 cigarettes each day in the past 30 days (n=39), and “20” = Smokers who reported smoking 20 or more cigarettes each day in the past 30 days (n=32).

For the remaining three substances, subgroups were created based on participants’ use of the substance during the last year that they were able to freely indulge in substance use. Typically, this time period was the 12 months prior to the arrest that resulted in their current incarceration. For 90 percent of participants, this “target period” of substance use fell within four years before the date that they participated in the study (see Figure 2). Information about participants’ drug use during the target period was obtained from the diagnostic interview that all participants underwent in order to determine their eligibility for the Residential Drug Abuse Program (RDAP). Guided by the structure of the interview, eight possible categories were derived for each of the three drugs under investigation in the current study: 1) drug never used or minimally used in lifetime (fewer than five times), 2) drug last used more than 3 years prior to target period (nature of prior use unknown), 3) last use of drug more than 1 year but less than three years prior to target period (nature of prior use unknown), 4) non-problem use in target period, 5) use during target period meeting criteria for abuse; self-reported but not verified by official collateral source, 6) use during target period meeting criteria for abuse; self-reported and also verified by official collateral source, 7) use during target period meeting criteria for dependence; self-reported but not verified by official collateral source, and, 8) use during target period meeting criteria for dependence; self-reported and also verified by official collateral source.

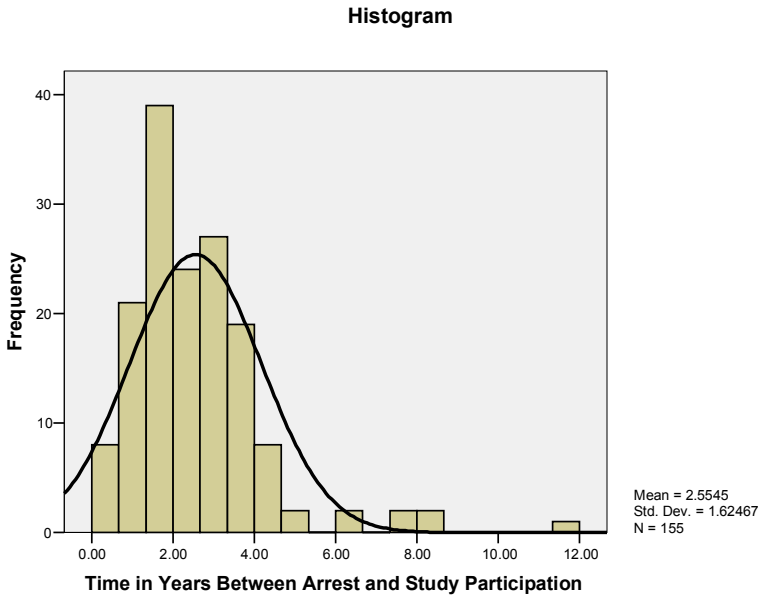


Figure 2: Length of Time in Years Between Arrest and Study Participation

These eight categories were subsequently collapsed to create three categories based on presumed clinical similarities: “O” = No or Minimal recent use (includes no or minimal lifetime use, and, last use more than three years prior to target period), “1” = Non-Problem Use in target period, and “2” = Problem Use in target period (includes abuse and dependence, not verified and verified). Table 1 shows the number of participants in each of these three groups for each of the three drugs.

Table 1: Number of Participants in the Levels of the Recent Drug Use History Variables

Drug	No/Minimal Use	Non-Problem Use	Problem Use	Total
Alcohol	***6***	58	89	153
Marijuana	35	42	73	150
Crack Cocaine	88	***15***	43	146

Note that the total number of participants varies among the three drug groupings; this is due to missing data, and to differing numbers of participants who fell into the “drug last used more than one year but less than three years ago” category across the three drugs, which was not used in the formation of the subgroups for each drug.

Although this three-level grouping strategy appears to be appropriate for the present sample with respect to Marijuana use, it did not yield sufficiently balanced cells for Alcohol and Crack Cocaine use. Perhaps due to the ubiquitous nature of alcohol, there were only six participants in the “No or Minimal” recent use category for alcohol. This subgroup was dropped, leaving subsequent Alcohol analyses to be conducted with only the Non-Problem Use vs. Problem Use groups. Only 15 participants reported Non-Problem crack cocaine use in the target period (perhaps due to the highly addictive nature of crack cocaine); thus, this subgroup was also dropped, leaving the Crack Cocaine analyses to be conducted with the No / Minimal Use and Problem Use subgroups.

Sample Characteristics and Validation of the Recent Drug Use History Grouping Variables

Table 2 shows participants' mean scores on the substance-related individual difference measures, when participants were grouped according to each of the above-described recent drug use history grouping variables. To test hypothesis 1, we conducted a series of F tests to determine whether these means differed significantly across the levels of the drug use history grouping variables. For measures with more than one scale, repeated measures mixed-model MANOVAs were performed, with Recent Drug Use History as the between-subjects variable and mean scale scores as the within-subjects variables. When a significant multivariate Recent Drug Use History X Scale interaction was found, a follow up between-subjects ANOVA was conducted to determine which of the scales differed across the levels of the grouping variable. For grouping variables with more than two levels, planned simple contrasts were performed to determine significant differences between levels. One-way ANOVAs with Recent Drug Use History as the between-subjects factor (and planned simple contrasts as needed) was used to test measures with a single scale. Protection against family-wise error inflation was obtained by applying a Bonferroni alpha correction that was based on the overall number of tests conducted for each measure. For example, for analyses using measures with one scale, and three levels of the Recent Drug Use History variable, a total of two follow up ANOVAs (i.e., planned contrasts) were performed, and the alpha level was lowered to 0.025. For all analyses, alpha levels were adjusted in this manner, depending on the number of scales in the measure and the number of levels of the Recent Drug Use History variable.

Table 2: Comparisons of Mean Scores on Substance-Related Individual Difference Measures, with Participants Grouped By Recent Use History

Substance and Measure	F-Test Results	Non-Problem Use Mean	Problem Use Mean
Alcohol			
SOCRATES (Change Motivation)	F(2,136) = 12.91*		
Problem Recognition	F(1,136.6) = 48.04*	4.93	14.68
Ambivalence	F(1,135.7) = 34.72*	2.63	7.73
Treatment Seeking	F(1,99.9) = 27.27*	13.91	23.95

Table 2- continued.

Substance and Measure	F-Test Results	Non-Problem Use Mean	Problem Use Mean
AASE-T (Craving)	F(3,143) = 5.34*		
Negative	F(1,142) = 42.3*	3.10	10.15
Social	F(1,145) = 17.33*	7.50	12.02
Physical	F(1,143.5) = 29.44*	1.76	6.34
Craving	F(1,143.5) = 23.26*	2.78	7.26
AASE-C (Self Efficacy)	F(3,137) = 8.47*		
Negative	F(1,139) = 29.2*	16.29	9.85
Social	F(1,139) = 4.89	11.93	9.42
Physical	F(1,139) = 15.32*	16.75	12.33
Craving	F(1,139) = 14.09*	15.79	11.34
CAGE (Alcohol Problems)	F(1,136) = 19.51*	1.07	2.22
SMAST (Alcohol Problems)	F(1,138) = 10.12*	4.57	5.77
DMQ (Drinking Motives)	F(3,143) = 6.23*		
Social	F(1,145) = 9.61*	8.36	11.74
Coping	F(1,138.8) = 34.73*	4.08	10.07
Enhancement	F(1,136.8) = 19.35*	6.38	10.97
Conformity	F(1,143.8) = 11.33*	2.19	4.91
AEI (Expectancies)	F(3,136) = 3.71*		
Positive	F(1,138) = 13.78*	16.7	24.54
Negative	F1,138) = 7.31*	11.41	16.38
Arousal	F(1,138) = 18.12*	13.52	23.17

Table 2- continued.

Substance and Measure	F-Test Results	Non-Problem Use Mean	Problem Use Mean
Sedative	F(1,138) = 1.47	19.09	22.02
CEOA (Expectancies)	F(6,138) = 2.85*		
Sociability	F(1,143) = 13.05*	13.04	17.56
Tension Reduction	F(1,143) = 6.29	4.86	6.14
Liquid Courage	F(1,143) = 14.89*	5.96	9.49
Sexuality	F(1,143) = 12.18*	5.11	7.57
Cognitive/ Behavioral Impairment	F(1,143) = 1.00	14.25	15.72
Risk and Aggression	F(1,143) = 14.04*	5.68	9.05
Self Perception	F(1,143) = 3.89	4.21	5.47

Substance and Measure	F-Test Results	Non-Use Mean	Problem Use Mean
Crack Cocaine			
SOCRATES (Change Motivation)	F(2,119) = 19.34*		
Problem Recognition	F(1,103.8) = 67.11*	15.68	29.23
Ambivalence	F(1,101.6) = 61.61*	8.67	16.12
Treatment Seeking	F(1,122.99) = 34.23*	25.38	36.60
CCQ (Craving)	F(4,105) = 5.06*		
Desire to Use	F(1,120) = 4.79	7.97	11.51
Intention and Planning	F(1,120) = 1.30	8.66	11.22
Anticipation of PositiveOutcome	F(1,120) = 4.62	12.64	16.86
Anticipation of Relief from Withdrawal or Dysphoria	F(1,118) = .79	20.47	21.54

Table 2- continued.

Substance and Measure	F-Test Results	Non-Use Mean	Problem Use Mean
Lack of Control	F(1,120) = 21.69*	13.26	23.27
CEQ-P (Expectancies)			
Well-Being Enhancement	F(1,123) = 1.67	6.91	8.93
Sexual Enhancement	F(1,123) = 4.08	8.74	12.72
Pain Reduction	F(1,123) = 15.9*	7.88	14.07
Increased Aggression	F(1,123) = 5.63	8.12	12.14
Social Facilitation	F(1,123) = .66	9.02	10.49
Social Withdrawal	F(1,123) = 25.41*	9.84	18.26
Increased Tension	F(1,102.77) = 11.7*	8.72	13.72

Substance and Measure	F-Test Results	Non-Use Mean	Non-Problem Use Mean	Problem Use Mean
Marijuana				
SOCRATES (Change Motivation)	F(4,278) = 10.85*			
Problem Recognition	F(2,124) = 35.5*	9.66	15.45**	22.83**
Ambivalence	F(2,125) = 26.1*	5.63	8.05**	12.06**
Treatment Seeking	F(2,85) = 15.16*	18.9	28.68*	32.63
MCQ (Craving)	F(4,120) = 3.28*			
Urges	F(2,119) = 14.86*	3.48	7.11	14.1**
Intent	F(2,128) = 12.8*	5.34	8.57	14.7**
Positive	F(2,116) = 14.22*	6.14	10.2	18.87**
Relief	F(2,135) = 7.54*	15.21	22.74	25.93
Lack of Control	F(2,127) = 15.69*	6.79	7.63	18.43**
MMQ (Motives)	F(8,268) = 8.11*			

Table 2- continued.

Substance and Measure	F-Test Results	Non-Use Mean	Non-Problem Use Mean	Problem Use Mean
Social	F(2,119) = 34.57*	2.81	8.44**	11.99**
Coping	F(2,125) = 32.16*	2.38	6.9**	11.34**
Enhancement	F(2,136) = 46.2*	4.06	10.10**	14.99**
Conformity	F(2,136) = .72	2.91	2.36	3.38
Experiential	F(2,119) = 11.53*	1.09	2.72	4.88

Substance and Measure	F-Test Results	0/Day Mean	5/Day Mean	10/Day Mean	20/Day Mean
Cigarette					
SOCRATES (Change Motivation)					
Problem Recognition	F(6,220) = 25.27*	9.37	22.64**	29.38**	30.13
Ambivalence	F(3,117) = 29.75*	5.89	11.55**	15.15**	15.41
Treatment Seeking	F(3,117) = 15.92*	13.37	30.27**	25.82	18.00**
QSU (Craving)	F(3,109) = 9.95*				
Need	F(3,109) = 36.82*	5.15	10.4	28.57**	32.87
Want	F(3,77) = 34.13*	14.78	35.2**	59.46**	64.19
SMQ (Motives)	F(9,289.8) = 8.05*				
Social	F(3,91) = 11.06*	0.6	3.86**	5.28	5.72
Coping	F(3,99) = 37.57*	0.5	4.33**	8.21**	8.75
Enhancement	F(3,110) = 25.22*	0.7	3.38**	6.31**	7.84
Conformity	F(3,102) = 2.29	0.5	1.38	2.21	1.63
SEQ (Self Efficacy)	F(3,121) = 1.05				
Internal Stimuli		15.77	10.88	6.05	2.97
External Stimuli		16.57	10.13	6.59	4.16

Table 2- continued.

*Significant difference in means, after application of Bonferroni alpha correction.
** Simple contrast - indicates cell mean significant from preceding cell mean, after Bonferroni correction applied.

The results of these analyses clearly support the validity of the drug use history grouping variables, by demonstrating that for each substance, participants who reported recent problematic use generally scored significantly higher on the corresponding measures than non-problem users and minimal users (on self-efficacy measures, problem users scored significantly lower than non problem users). One particularly interesting finding, however, is the strikingly high level of lifetime alcohol use problems reported by the group of participants classified as recent Non-Problem alcohol users. While the mean SMAST score of recent Problem alcohol users was significantly higher than the mean SMAST score of recent Non Problem users, ***both*** groups' mean score was higher than the established cutoff score of three, which is typically regarded as a "red flag" suggestive of problematic drinking. In fact, only nine percent of the entire sample had a score lower than three on this measure. Similarly, the mean score on the CAGE for the Non Problem alcohol use group was higher than liberal cutoff indicator score of one, though still lower than the conservative cutoff score of two. Taken together, these findings suggest that perhaps the Non Problem and Problem alcohol use groups may be somewhat similar in terms of lifetime drinking history, perhaps differing mainly on the recentness and / or severity of problematic drinking.

Another illuminating finding was the pattern of results for Crack Cocaine relative to the findings observed for Alcohol and Marijuana. Like the Problem Users of Alcohol and Marijuana, Problem Crack Cocaine Users exhibited significantly higher scores on the SOCRATES, indicating higher motivation for changing crack use. However, in contrast to the findings for Alcohol and Marijuana, there were few significant differences between Non Crack Users and Problem Crack Users on the craving and expected consequences of use measures. Furthermore, all of the scales that did differentiate the groups on these two measures were related to the experience and expectation of negative consequences of crack cocaine use.

Content Validity of Cues in Each Substance Category

In a design improvement over our previous study using this methodology, participants in the present study were asked to identify the substance category that each cue belonged to, after recording their reactivity to the cue using the three rating scales. This was done in order to test the first element of hypothesis 2, which was to assess the degree to which each cue was recognizable as a member of its intended substance category. To this end, content validity for each cue was quantified by calculating the percentage of respondents who correctly identified the category that the

cue was intended to represent. For food cues, identification was considered correct regardless of which of the two food categories (Unhealthy or Healthy) was used, due to the subjective nature of these categories. Similarly, either non-alcoholic beverage category was considered correct for the caffeinated and non-caffeinated beverage cues, in order to allow for individual differences in awareness about caffeinated beverages, and differences in ease of identification among the cues. (Occasionally, participants identified milk or orange juice as "healthy food"; this was also accepted as a correct identification.) Table 3 displays the percentage of correct identification for each cue in each of the seven categories.

Table 3: Cue Identification Percentages

Category	**Percentage of subjects correctly identifying cue category**
Alcohol	
Beer	
3. Mug beer pour	97.4
10. Beer pitcher and glass	98.7
23. Variety of beers in store cooler	98.1
30. Male drinking beer mug	98.7
37. Frost mug beer with foam	99.4
51. Female drinking beer mug	94.8
Liquor	
14. Red mixed drink with lime	87.7
19. Whiskey shot pouring	98.7
42. Southern Comfort shot	100
Wine	
8. Red wine in glass	95.5
36. White wine in glasses toasting	96.8
46. White wine bottle and glass	99.4
Marijuana	
2. Lit joint in male hand	94.2
15. Bong and bag of pot	97.4
24. Pot pipe and smoke	**82.6***
29. Bag of pot	98.1
38. Packing pot into pipe	98.7
54. Male smoking joint	96.8
Crack	
4. Crack rocks and paperclip 1	88.4
18. Crack rocks and paperclip 2	89.0
22. Crack rocks in hand by pocket	92.9
32. Crack rock in can pipe	**82.6***
45. Crack rocks, pipe, lighter	96.0
50. Crack rock	**80.0***

Table 3-continued.

Category	Percentage of subjects correctly identifying cue category
Cigarettes	
7. Lit cigarette in female hand	100
13. Male cigarette exhale	99.4
27. Female lighting cigarette	**74.8***
35. Cigarette in ashtray blue	98.7
41. Male lighting cigarette	94.2
47. Cigarettes in ashtray	95.5
Non-Alcoholic Beverages without Caffeine	
6. Orange juice carton and glass	100
17. Lemon lime soda	95.9
21. Milk pouring	99.3
33. Apple juice	97.9
43. Twister fruit juice	100
48. Orange juice pouring	97.3
Non-Alcohol Beverages with Caffeine	
1. Colas 1	96.6
12. Tea kettle pouring mug teabag	94.2
25. Diet colas	98.6
28. Coffee pouring	97.9
39. Colas 2	99.3
53. Tea in china cup with kettle	98.6
Healthy Food	
5. Cut orange and grapefruit	99.3
11. Homemade salad	98.7
26. Homemade mixed fruit tray	100
34. Restaurant salad	100
40. Celery with knife	99.3
49. Restaurant mixed fruit tray	98.0
Unhealthy Food	
9. Pizza	100
16. Chocolate Pie	98.6
20. Cheeseburger and fries	99.3
31. Ice cream sundae	98.6
44. Spaghetti and sauce	99.3
52. Chicken fingers and fries	97.9

* Dropped due to low content validty
Number preceding each cue represents the cue's position in Presentation Order #1

Based on the observed percentages, a cue was considered to be a "poor performer" in terms of content validity if it was correctly identified by less than 85% of all participants. Using this cutoff, one cigarette cue, one marijuana cue, and two crack cocaine cues were dropped from the cue sets as poor performers. Ratings for these cues were dropped from subsequent analyses. Additionally, when a participant incorrectly identified a drug cue, her arousal, approach, and avoidance responses for that particular cue were dropped.

Reliability of Reactivity Ratings for Cues in Each Substance Category

Once the content validity of the individual cues was determined, the second element of hypothesis 2 was undertaken, which was to evaluate the reliability of the remaining cues within each category. While some variation was expected due to the unique features of each individual cue, it was expected that, overall, participants' reactions to the cues in each category would show internal consistency. Table 4 shows that Cronbach's alphas for the four drug categories ranged from .85 to .97, and from .58 to .77 for the four comparison cue categories, indicating good reliability for each substance category. As expected, the relationship of the cues to the overall scale was not additive, but rather reflected that each cue reliably represented the category.

Table 4: Cronbach's Alpha Estimates of Internal Consistency for Approach and Avoidance Ratings by Substance Category

Substance Category	**Approach Rating**	**Avoidance Rating**
Alcohol	.93	.88
Marijuana	.97	.91
Crack Cocaine	.92	.85
Cigarettes	.98	.95
Unhealthy Food	.72	.77
Healthy Food	.74	.66
Non-Alcoholic Non-Caffeinated	.66	.58
Non-Alcohol Caffeinated	.67	.71

Validation of the Four Drug Cue Sets Using Arousal Ratings – the Arousal Control Analysis

Arousal is conceptualized as an index of general emotional activation, and as such, level of arousal reactivity was predicted (in hypothesis 3) to increase as a function of the intensity participants' level of recent involvement with each substance. Based on this presumed relationship, we planned to use participants' arousal ratings as a methodological check, to validate the two new substance cue sets introduced in this study (marijuana and crack cocaine), and to replicate the validation of the two substance cue sets from our earlier study (alcohol and cigarettes) with our current clinical sample. To accomplish this validation, we utilized an arousal control design based upon the same three questions that were used to conduct the approach and avoidance reactivity analyses.

A full report of these analyses can be found in Appendix B. In sum, the three-question arousal control analyses effectively demonstrated that when participants were grouped according to their recent history of Cigarette use, Marijuana use, and Crack Cocaine use, the differences in arousal to those particular substance cues observed between the use levels could not be attributed to differences in general arousability (drug cues versus comparison cues), or to differences in arousability to drug cues in general (drug cues versus other drug cues). Additionally, when participants were grouped according to their recent history of Cigarette use, Marijuana use, and Crack Cocaine use, comparisons of the relative levels of arousal to matched drug cues versus arousal to unmatched drug cues and non-drug comparison cues yielded potentially informative variability in arousal reactivity patterns.

In contrast, and unexpectedly, when participants were grouped according to recent Non-Problem and Problem alcohol use, the arousal control analyses failed to demonstrate significant group differences in arousal reactivity to Alcohol cues. However, consideration of the sample as a whole (that is, collapsing the Alcohol groups into one and examining the multivariate within-subjects reactivity patterns across cue sets) did reveal significant arousal reactivity patterns to the alcohol cues relative to both the four comparison cue sets and the three other drug cues sets. The findings reported above regarding the recent Non Problem drinkers' reporting of lifetime alcohol use problems suggest that perhaps the entire sample shares more commonalities than differences with regard to their history of alcohol use, which may account for the lack of difference in arousal to alcohol cues between the two groups.

Approach and Avoidance Reactivity as Separate Reactivity Dimensions

Examination of Multidimensional 'Reactivity Space' Across Cue Categories

As described in hypothesis 4, we planned to explore the approach and avoidance reactivity dimensions in four ways. First, before breaking the sample down into clinically meaningful subgroups to look for differences in reactivity to the substance cues, an examination of the full sample's Approach and Avoidance reactivity to each cue type was conducted to determine whether reactivity to each cue category had emerged as expected; that is, in accord with the hypothesis that approach and avoidance inclination each represent a distinct reactivity domain. Given the nature of the sample (i.e., a heterogeneous group of women with diagnosed with a variety of substance use disorders who are seeking treatment), it was expected that within each of the drug cue categories (cigarettes, alcohol, marijuana, and crack cocaine), there would be some participants whose responses to the drug cues were characterized by approach inclination, some whose responses were characterized by avoidance inclination, some by ambivalence, and some by indifference. The comparison cue sets were selected to elicit a range of "universal" response patterns; that is, patterns that support the separate measurement of approach and avoidance, yet are unrelated to individual differences in substance use history.

Figure 3 shows scatterplots of the whole sample's responses to each of the drug and comparison cue sets. Visual inspection of the scatterplots for the alcohol cues and the cigarette cues show that these cue sets performed as expected given the nature of the sample, with a portion of respondents falling into each of the four quadrants. While the scatterplots for marijuana and crack cocaine also show respondents falling within each quadrant of reactivity space, indifferent responders are underrepresented for marijuana, and approach-oriented responders are underrepresented for crack cocaine.

Unhealthy Food

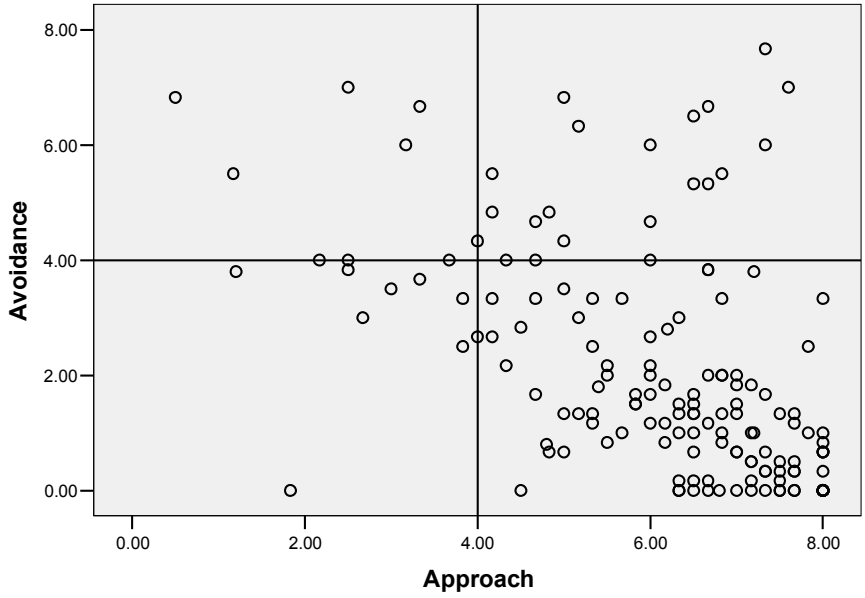


Figure 3: Scatterplots of Approach and Avoidance - Drug and Comparison Cues

Healthy Food

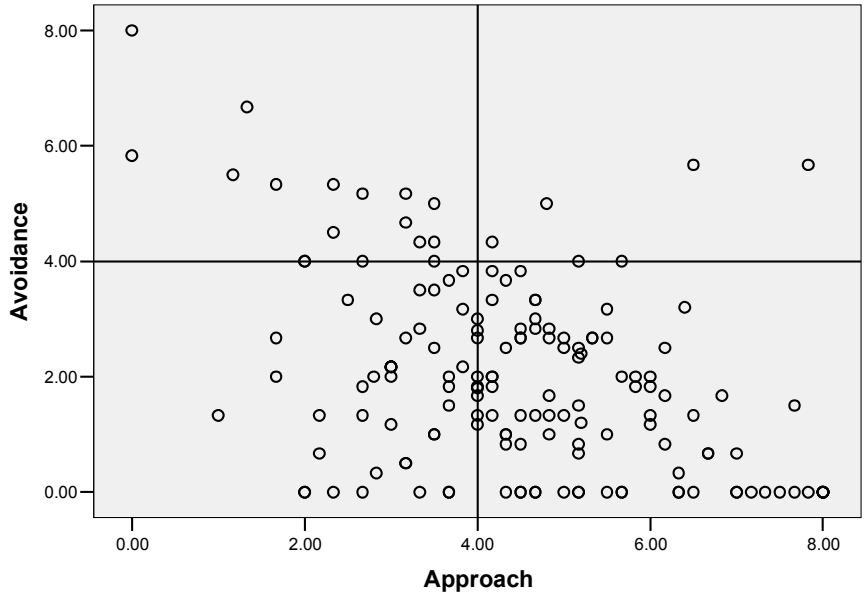


Figure 3: Continued.

Non Alcoholic Non Caffeinated Beverages

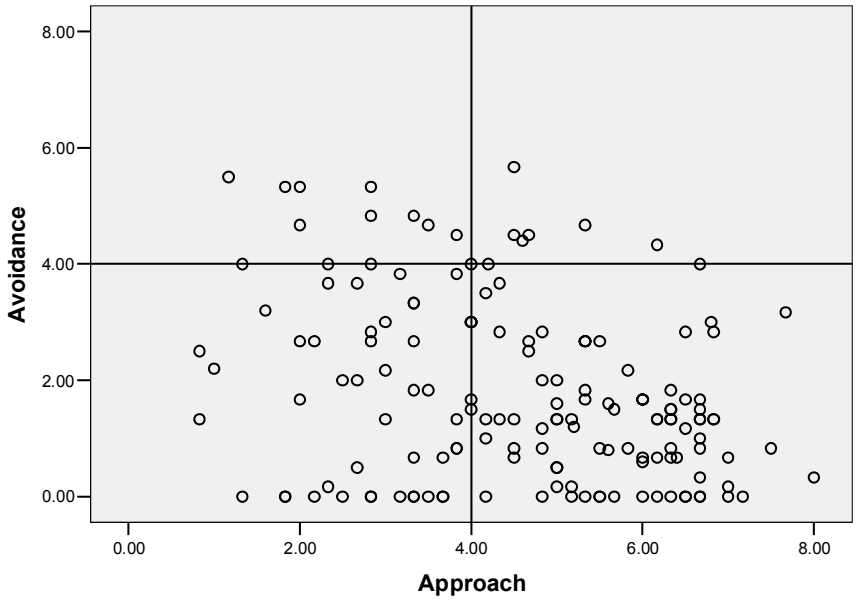


Figure 3: Continued.

Non Alcoholic Caffeinated Beverages

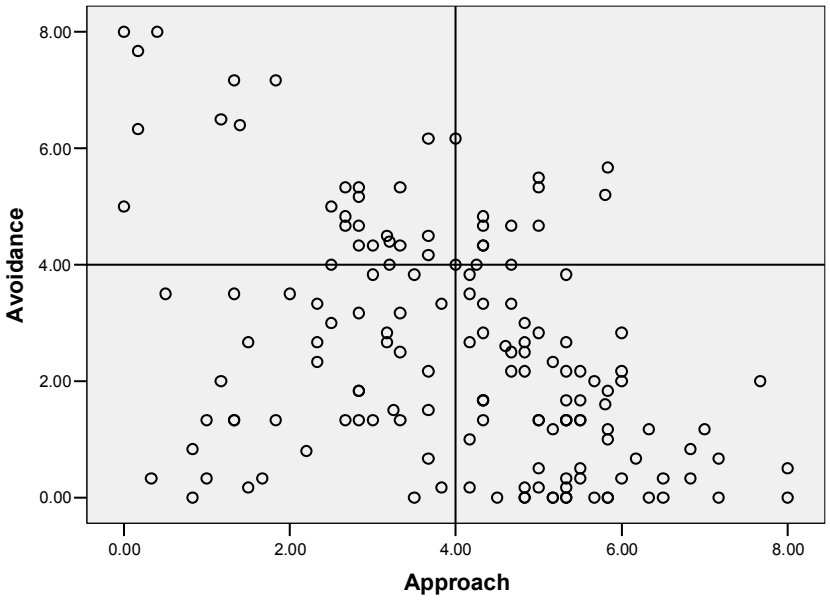


Figure 3: Continued.

Marijuana

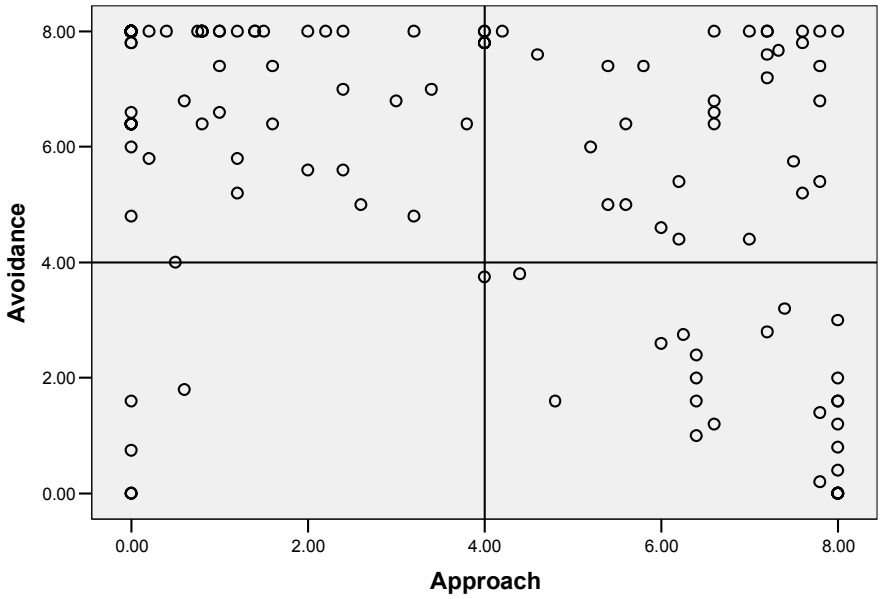


Figure 3: Continued.

Crack Cocaine

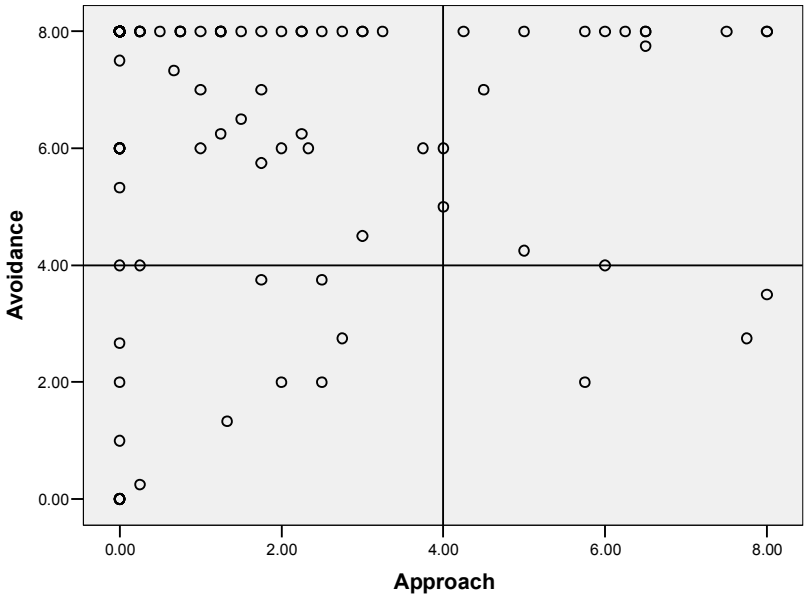


Figure 3: Continued.

Cigarettes

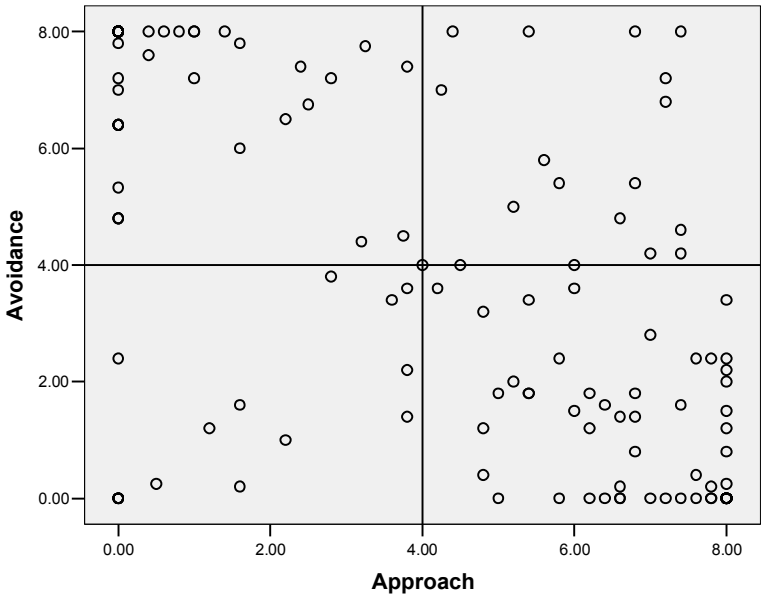


Figure 3: Continued.

Alcohol

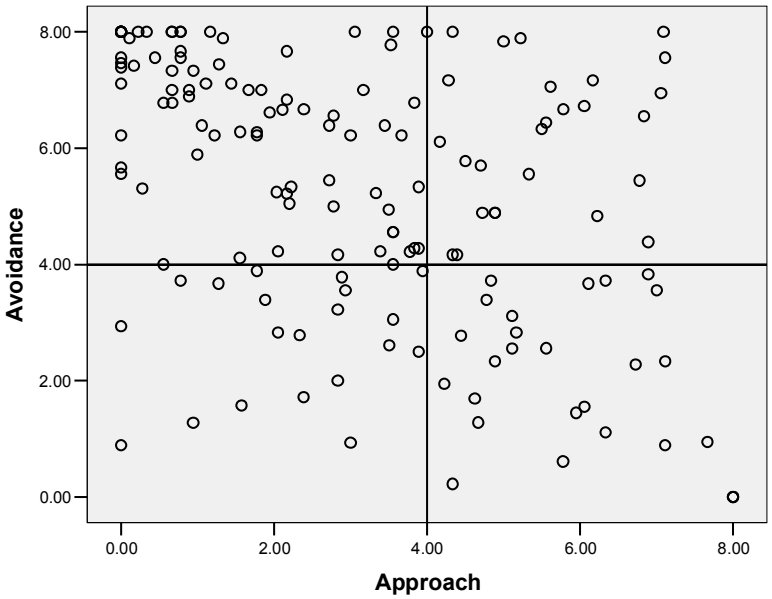


Figure 3: Continued.

Examination of the scatterplots for the four comparison cue sets revealed that the Unhealthy Food cues evoked a response pattern heavily biased toward the two quadrants characterized by high levels of the approach dimension, with indifferent and avoidant responders notably underrepresented. Participants' response pattern toward both the Healthy Food and the Non-Alcoholic / Non-Caffeinated Beverage cue sets was characterized by a relatively low level of Avoidance, such that the avoidant and ambivalent quadrants were sparsely populated. Responses to the Non-Alcoholic Caffeinated Beverage cue set showed a more balanced distribution across the four quadrants, although the magnitude of both approach and avoidance in the ambivalent quadrant was low relative to the levels evinced in the approach and avoidant quadrants. Together, the four sets of comparison cues appeared to provide an adequate range of reactivity space against which to compare drug cue reactivity.

Further support for the consideration of approach and avoidance as distinct reactivity domains can be gleaned from Table 5, which shows the correlation between Approach and Avoidance for each of the drug and comparison cue categories. The generally moderate size of these correlations further supports the hypothesis that while approach and avoidance are related, they are not simply reciprocals of one another.

Table 5: Correlations Between Approach and Avoidance Ratings for Drug Cue Sets and Comparison Cue Sets

Comparison Cues	**Approach and Avoidance Correlation**	**Drug Cues**	**Approach and Avoidance Correlation**
Unhealthy Food	-.519*	Alcohol	-.468*
Healthy Food	-.433*	Cigarettes	-.658*
Non-Alcohol, No Caffeine Beverage	-.314*	Marijuana	-.498*
Non-Alcohol, Caffeine Beverage	-.445*	Crack Cocaine	-.078

* Significant at .01 level

Analysis Strategy for Testing the Use History – Approach / Avoidance Reactivity Relationship

As described in the hypothesis 4, the second exploration of approach and avoidance reactivity was conducted by posing and answering three questions:

1) Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to non-drug comparison cues?

2) When participants are grouped according to recent use of a specific drug, how does reactivity to cues for that drug relate to reactivity to non-drug comparison cues?

3) Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to cues for other drugs?

A specific set of analyses was designed to address each of the three questions. The full set of analyses was repeated for each of the two reactivity indices, Approach and Avoidance. To answer the first question, a set of four mixed-model MANOVAs was conducted; one for each of the four drug cue sets (Cigarettes, Alcohol, Marijuana, and Crack Cocaine). In these analyses, recent drug use history served as the between-subjects factor (called "Drug Use History"), and reactivity to the drug cue set and the four comparison cue sets served as the within-subjects factor (called "Cue Type"). A significant multivariate Drug Use History X Cue Type interaction indicates that reactivity to the cues varies as a function of recent drug use history. When the multivariate interaction was significant, a follow up between-subjects ANOVA, with reactivity to each of the five cue sets as the dependent variables, was conducted to test the prediction that the multivariate interaction was caused by significant variation in reactivity to the drug, whereas reactivity to the comparison cues did not vary as a function of recent drug use history.

To answer the second question, an additional set of follow up analyses was conducted for each of the significant multivariate Drug Use History X Cue Type interactions. In these analyses, a series of within-subjects ANOVAs was conducted to compare reactivity to the drug cue set to reactivity to the four comparison cue sets. One ANOVA was performed for each level of each Drug Use History grouping variable. The goal of these analyses was to examine the strength of reactivity to the drug cues relative to the strength of reactivity to the comparison cues within each level of the Drug Use History grouping variable.

In order to protect against family-wise error inflation, a Bonferroni alpha correction was applied to each series of follow up analyses. Under each original MANOVA, one between-subjects follow up ANOVA with five dependent variables, and two, three, or four within-subjects ANOVAs was performed. Therefore, the family of univariate follow up tests equaled 7, 8, or 9, so the alpha level for each test was lowered to .007 or .006, as indicated.

To answer the third question, a new set of four mixed-model MANOVAs was conducted; one for each of the four drug cue sets (Cigarettes, Alcohol, Marijuana, and Crack Cocaine). In these analyses, recent drug use history served as the between-

subjects factor (called “Drug Use History”), and reactivity to the matched drug cue set and the other drug cue sets served as the within-subjects factor (called “Cue Type”). A significant multivariate Drug Use History X Cue Type interaction indicates that reactivity to the cues varies as a function of recent drug use history. When the multivariate interaction was significant, a follow up between-subjects ANOVA, with reactivity to each of the four cue sets as the dependent variables, was conducted to test the prediction that the multivariate interaction was caused by significant variation in reactivity to the matched drug, whereas reactivity to the other three drug cue sets did not vary as a function of recent drug use history. The alpha correction described above was also applied to these analyses to protect against family-wise error inflation.

Approach Reactivity as a Function of Recent Substance Use History

Approach Analyses Question 1: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to non-drug comparison cues?

Cigarettes. Mean approach ratings for cigarettes and the four comparison cue sets, with the participants grouped by current smoking status, are presented in Figure 4, first panel. As predicted, the multivariate Cigarette Use X Cue Type interaction was significant, $F(4, 12) = 12.79$, $p < .001$, $eta^2 = .30$. A follow up between-subjects ANOVA with the five cue types as dependent variables revealed that approach ratings to cigarettes differed between Non-Smokers and the three levels of Smokers, $F(3, 60.2) = 96.95$, $p < .001$, whereas there were no significant differences between smoking status groups in approach ratings to the four sets of comparison cues: Unhealthy Food, $F(3, 121) = 1.15$, ns; Healthy Food, $F(3, 99.48) = .67$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(3, 121) = .51$, ns; Non-Alcoholic Caffeinated Beverages, $F(3, 121) = .94$, ns. Planned contrasts showed that mean approach ratings to cigarette cues increased significantly between Non-Smokers and 5 or less per day Smokers, $t(23.19) = 6.31$, $p < .001$, and between 5 or less per day Smokers and 10 per day Smokers, $t(40.12) = 4.29$, $p < .001$, but not between 10 per day Smokers and 20 or more per day Smokers, $t(66.7) = 2.67$, ns.

Alcohol. Mean approach ratings for Alcohol cues and the four comparison cue sets, with the participants grouped by recent alcohol use, are presented in Figure 4, second panel. As predicted, the multivariate Alcohol Use X Cue Type interaction was significant, $F(4, 142) = 3.11$, $p = .02$, $eta^2 = .08$. A follow up between-subjects ANOVA, with approach for each of the five cue types as dependent variables, revealed that approach ratings to alcohol cues increased between Non-Problem and Problem Users, $F(1, 145) = 8.99$, $p = .003$, $eta^2 = .06$. There were no significant differences between alcohol groups in approach ratings to the four sets of comparison cues: Unhealthy Food, $F(1, 145) = .71$, ns; Healthy Food, $F(1, 145) = .09$, ns; Non-Alcoholic, Non-Caffeinated Beverages, $F(1, 145) = .03$, ns; Non-Alcoholic, Caffeinated Beverages, $F(1, 145) = 2.88$, ns.

Marijuana: Mean approach ratings for marijuana cues and the four comparison cue sets, with the participants grouped by recent marijuana use, are presented in Figure

4, third panel. As predicted, the multivariate Marijuana Use X Cue Type interaction was significant, $F(8, 288) = 9.16$, $p < .001$, $eta^2 = .20$. A follow up between-subjects ANOVA, with mean approach for each cue type as the dependent variables, revealed a significant main effect for approach to marijuana cues, $F(2, 147) = 32.83$, $p < .001$, $eta^2 = .31$; however, there were no significant group differences in approach ratings for the four sets of comparison cues: Unhealthy Food, $F(2, 147) = 4.02$, ns.; Healthy Food, $F(2, 147) = 3.90$, ns.; Non-Alcoholic, Non-Caffeinated Beverages $F(2, 147) = 3.38$, ns.; Non-Alcoholic, Caffeinated Beverages $F(2, 147) = 1.14$, ns. Planned contrasts showed that mean approach ratings to marijuana cues increased significantly between Minimal Users and Non-Problem Users, $t(68.69) = 4.02$, $p < .001$, and also between Non-Problem Users and Problem Users $t(97.43) = 4.38$, $p < .001$.

Crack Cocaine. Finally, mean approach ratings for crack cocaine cues and the four comparison cue sets, with the participants grouped by recent crack cocaine use, are presented in Figure 4, fourth panel. As predicted, the multivariate Crack Cocaine Use X Cue Type interaction was significant, $F(4, 126) = 7.20$, $p < .001$, $eta^2 = .19$. A series of five follow up between-subjects ANOVAs, one for each cue type, revealed a significant main effect for approach to crack cocaine cues, $F(1, 47.65) = 21.12$, $p < .001$, $eta^2 = .22$; however, there were no significant group differences in approach ratings for the four sets of comparison cues: Unhealthy Food, $F(1, 129) = .61$, ns.; Healthy Food, $F(1, 129) = 1.73$, ns.; Non-Alcoholic, Non-Caffeinated Beverages $F(1, 67.35) = 2.62$, ns.; Non-Alcoholic, Caffeinated Beverages $F(1, 129) = .26$, ns.

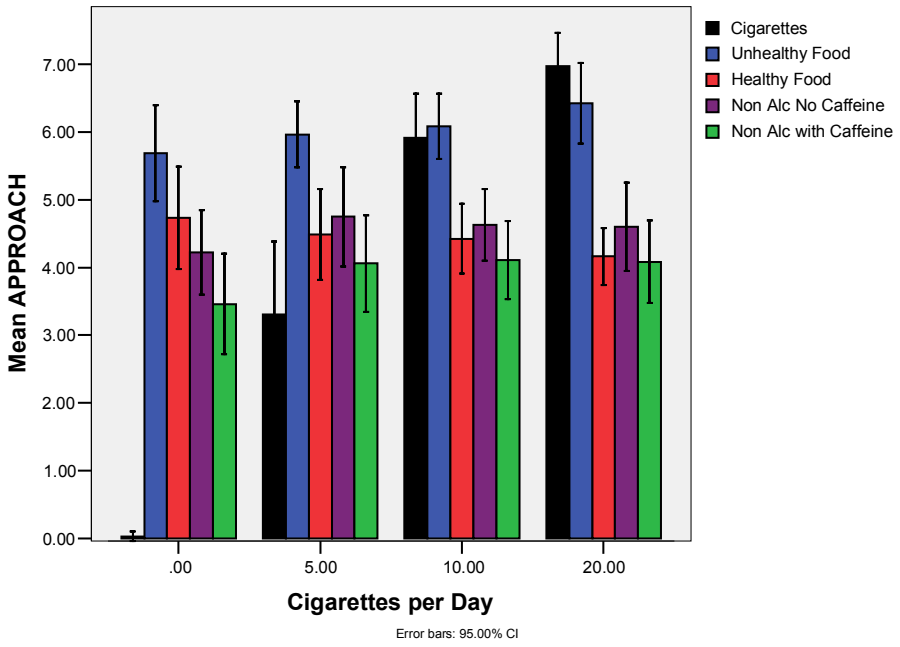
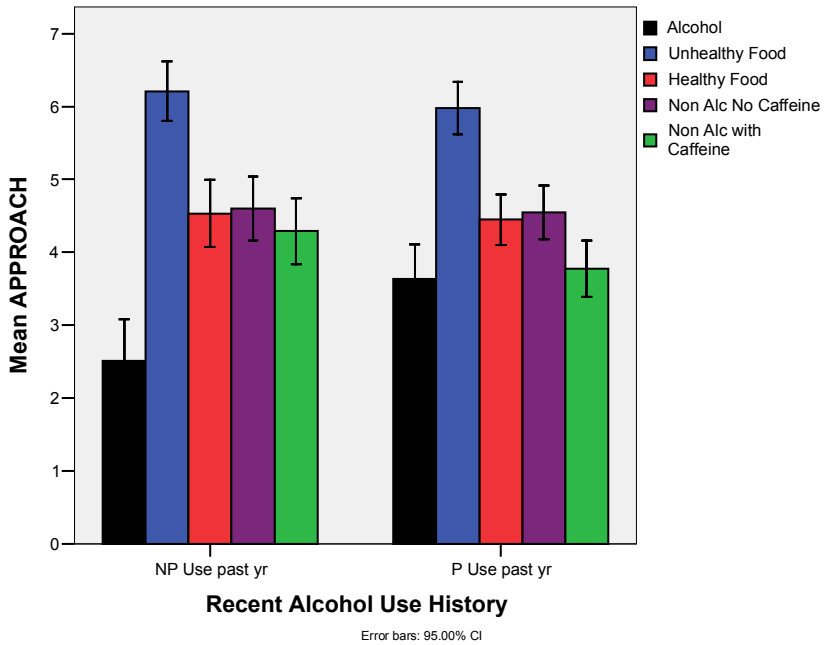


Figure 4: Approach - Drug vs. Comparison Cues



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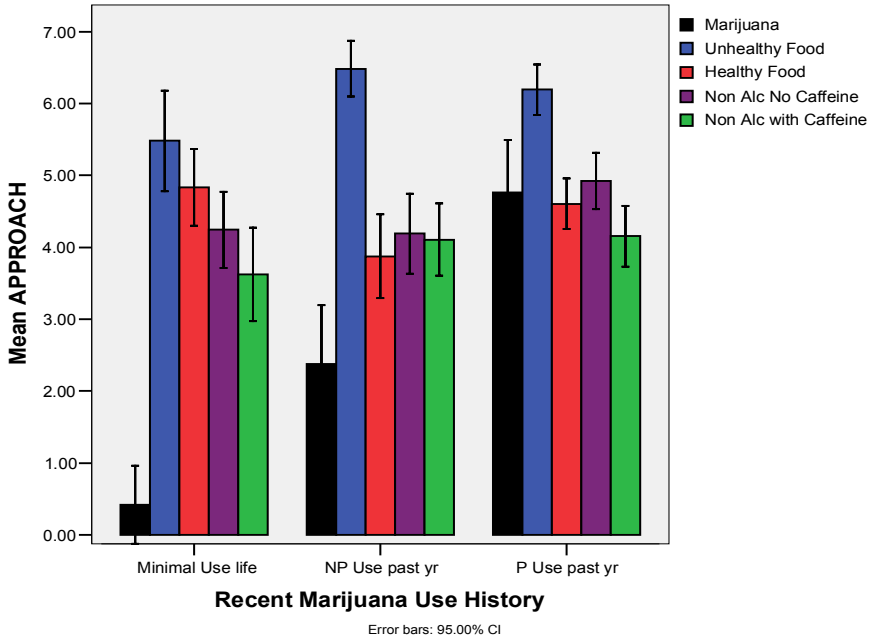

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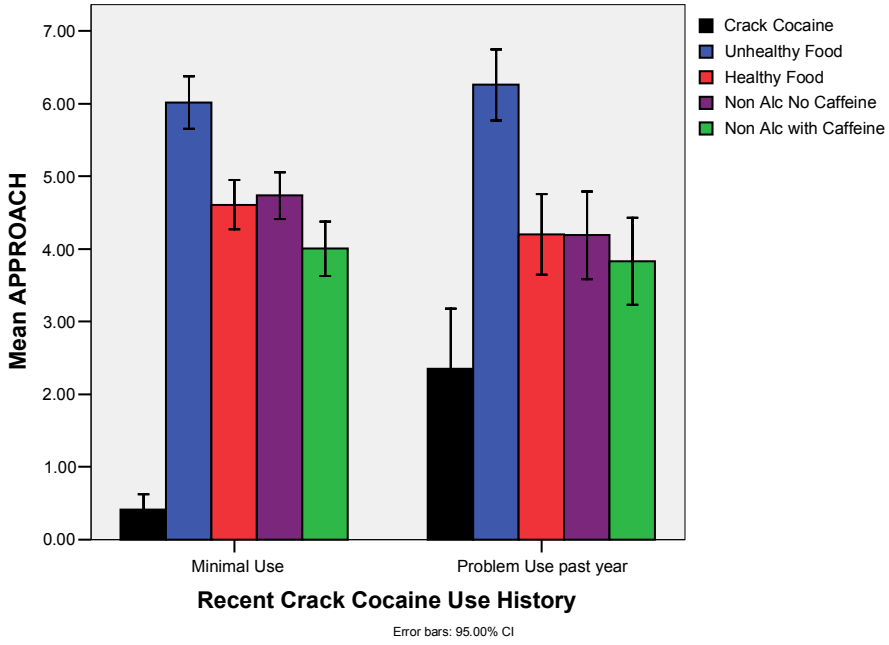


Figure 4: Continued.

Approach Analyses Question 2: When participants are grouped according to recent use of a specific drug, how does reactivity to cues for that drug relate to reactivity to non-drug comparison cues?

Cigarettes. For Non-Smokers, there was a significant main effect for cue type $F(4, 116) = 66.13$, $p < .001$, $eta^2 = .70$. Simple contrasts showed that Non-Smokers' mean approach to the cigarette cue set was significantly lower than their mean approach to each of the comparison cue sets: Unhealthy Food vs. Cigarettes, $F(1, 29) = 269.65$, $p < .001$, $eta^2 = .90$; Healthy Food vs. Cigarettes, $F(1, 29) = 166.73$, $p < .001$, $eta^2 = .85$; Non-Alcoholic Non-Caffeinated Beverages vs. Cigarettes, $F(1, 29) = 185.18$, $p < .001$, $eta^2 = .87$; Non-Alcoholic Caffeinated Beverages vs. Cigarettes, $F(1, 29) = 90.92$, $p < .001$, $eta^2 = .76$. For 5 or fewer per day Smokers, there was also a main effect for cue type $F(2.56, 58.67) = 8.32$, $p < .001$, $eta^2 = .27$. Simple contrasts show that 5 or fewer per day Smokers' mean approach to cigarettes was significantly lower than their approach to Unhealthy food, $F(1, 23) = 19.36$, $p < .001$, $eta^2 = .46$, and not significantly different from their approach reactivity to Healthy Food, $F(1, 23) = 3.49$, ns; Non-Alcoholic Non-Caffeinated Beverages $F(1, 23) = 4.71$, ns; and Non-Alcoholic Caffeinated Beverages $F(1, 23) = 1.53$, ns. For 10 per day Smokers, there was also a main effect for cue type $F(2.86, 108.66) = 12.56$, $p < .001$, $eta^2 = .25$. Simple contrasts showed that 10 per day Smokers' mean approach to cigarettes was significantly higher than their approach to Healthy Food, $F(1, 38) = 12.2$, $p = .001$, $eta^2 = .24$, and Non Alcoholic Caffeinated Beverages, $F(1, 38) = 19.94$, $p < .001$, $eta^2 = .34$. There was no significant difference between 10 per day Smokers' mean approach to Cigarette cues and their approach to Unhealthy Food, $F(1, 38) = 1.05$, ns, and Non Alcoholic Non Caffeinated Beverages, $F (1, 38) = 7.46$, ns. For 20 or more per day Smokers, there was a main effect for cue type, $F(4, 124) = 28.02$, $p < .001$, $eta^2 = .48$. Planned contrasts showed that 20 or more per day Smokers' approach to Cigarette cues was significantly higher than their approach to Healthy Food, $F(1, 31) = 61.62$, $p < .001$, $eta^2 = 67$, Non Alcoholic Non Caffeinated Beverages, $F(1, 31) = 37.05$, $p < .001$, $eta^2 = .54$, and Non Alcoholic Caffeinated Beverages, $F(1, 31) = 80.29$, $p < .001$, $eta^2 = .72$. There was no difference between 20 or more per day Smokers' approach to cigarettes and Unhealthy Food, $F(1, 31) = 2.5$, ns.

Alcohol. For Non-Problem alcohol users, there was a significant main effect for cue type $F(2.95, 454.99) = 62.78$, $p < .001$, $eta^2 = .29$. Simple contrasts showed that Non-Problem users' mean approach to the alcohol cue set was significantly lower than their mean approach to each of the comparison cue sets: Unhealthy Food, $F(1, 57) = 118.50$, $p < .001$, $eta^2 = .68$; Healthy Food, $F(1, 57) = 30.16$, $p < .001$, $eta^2 = .35$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 57) = 31.83$, $p < .001$, $eta^2 = .36$; Non-Alcoholic Caffeinated Beverages, $F(1, 57) = 24.64$, $p < .001$, $eta^2 = .30$. For Problem alcohol users, there was a significant main effect for cue type, $F(2.9, 255.07) = 26.09$, $p < .001$, $eta^2 = .23$. Simple contrasts showed that Problem Users' approach to Alcohol cues was significantly lower than their mean approach to Unhealthy Food, $F(1, 88) = 68.54$, $p < .001$, $eta^2 = .44$, and Non-Alcoholic Non-Caffeinated Beverages, $F(1, 88) = 8.05$, $p = .006$, $eta^2 = .08$. There was no significant difference between Problem Users' approach to Alcohol cues versus Healthy Food cues, $F(1, 88) = 6.56$, ns, and versus Non-Alcoholic Caffeinated Beverage cues, $F(1, 88) = .20$, ns.

Marijuana. For Non / Minimal Users, there was a significant main effect for cue type, $F(3.65, 124.03) = 55.77$, $p < .001$, $eta^2 = .62$. Simple contrasts showed that Non / Minimal Users' mean approach to the Marijuana cue set was significantly lower than their mean approach to each of the comparison cue sets: Unhealthy Food, $F(1, 34) = 156.72$, $p < .001$, $eta^2 = .82$; Healthy Food, $F(1, 34) = 153.45$, $p < .001$, $eta^2 = .82$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 34) = 106.2$, $p < .001$, $eta^2 = .76$; Non-Alcoholic Caffeinated Beverages, $F(1, 34) = 56.76$, $p < .001$, $eta^2 = .63$. For Non-Problem Users, there was also a significant main effect for cue type, $F(2.67, 109.18) = 31.4$, $p < .001$, $eta^2 = .43$. Simple contrasts showed that Non-Problem Users' mean approach for the Marijuana cue set was significantly lower than their mean approach to each of the comparison cue sets: Unhealthy Food, $F(1, 41) = 89.07$, $p < .001$, $eta^2 = .69$; Healthy Food, $F(1, 41) = 9.07$, $p = .004$, $eta^2 = .18$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 41) = 13.74$, $p = .001$, $eta^2 = .25$; Non-Alcoholic Caffeinated Beverages, $F(1, 41) = 13.5$, $p = .001$, $eta^2 = .25$. For Problem Users, there was also a significant main effect for cue type, $F(2.12, 152.32) = 12.29$, $p < .001$, $eta^2 = .15$. Simple contrasts showed that Problem Users' mean approach for the Marijuana cue set was significantly lower than their mean approach to for the Unhealthy Food cue set, $F(1, 72) = 16.83$, $p < .001$, $eta^2 = .19$. However, there were no significant differences between Problem Users' mean approach for the Marijuana cue set and the remaining three comparison cue sets: Healthy Food, $F(1, 72) = .14$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 72) = .13$, ns; Non-Alcoholic Caffeinated Beverages, $F(1, 72) = 2.22$, ns.

Crack Cocaine. For Non / Minimal Users, there was a significant main effect for cue type, $F(3.78, 329.06) = 212.54$, $p < .001$, $eta^2 = .71$. Simple contrasts showed that Non / Minimal Users' mean approach to the Crack Cocaine cue set was significantly lower than their mean approach to each of the comparison cue sets: Unhealthy Food, $F(1, 87) = 785.13$, $p < .001$, $eta^2 = .90$; Healthy Food, $F(1, 87) = 478.17$, $p < .001$, $eta^2 = .85$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 87) = 454.56$, $p < .001$, $eta^2 = .85$; Non-Alcoholic Caffeinated Beverages, $F(1, 87) = 289.14$, $p < .001$, $eta^2 = .77$. For Problem Users, there was a significant main effect for cue type, $F(2.32, 97.24) = 21.4$, $p < .001$, $eta^2 = .34$. Simple contrasts showed that Problem Users' mean approach to Crack Cocaine cues was significantly lower than their mean approach to Unhealthy Food, $F(1, 42) = 97.35$, $p < .001$, $eta^2 = .70$, Healthy Food, $F(1, 42) = 10.62$, $p = .002$, $eta^2 = .20$, and Non-Alcoholic Non-Caffeinated Beverages, $F(1, 42) = 10.11$, $p = .003$, $eta^2 = .19$. However, there was no significant difference between Problem Users' mean approach to Crack Cocaine cues and the Non-Alcoholic Caffeinated Beverages, $F(1, 42) = 7.18$, ns.

Approach Analyses Question 3: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to cues for other drugs?

Cigarettes. Mean approach ratings for cigarettes and the three other drug cue sets, with the participants grouped by current smoking status, are presented in Figure 5, first panel. As predicted, the multivariate Cigarette Use X Cue Type interaction was significant, $F(3, 9) = 11.94$, $p < .001$, $eta^2 = .23$. A follow up between-subjects ANOVA with the four drug cue types as dependent variables revealed that approach reactivity to cigarette cues increased significantly between Non-Smokers and the three levels of

Smokers, $F(3, 60.2) = 96.95$, $p < .001$, whereas there were no significant differences between Non-Smokers' and the three levels of Smokers' approach to the other three drugs: Alcohol, $F(3, 121) = 1.26$, ns; Marijuana, $F(3, 121) = 1.27$, ns; Crack Cocaine, $F(3, 98.27) = 2.82$, ns.

Alcohol. Mean approach ratings for Alcohol cues and the three other drug cue sets, with the participants grouped by recent alcohol use, are presented in Figure 5, second panel. As predicted, the Alcohol Use X Cue Type interaction was significant, $F(2.7, 391.11) = 3.12$, $p = .03$, $eta^2 = .02$. A follow up between-subjects ANOVA, with mean approach to each of the four cue types as the dependent variables, showed that mean approach to Alcohol cues increased significantly between Non-Problem and Problem users, $F(1, 145) = 8.99$, $p = .003$, $eta^2 = .06$. There were no differences in approach reactivity to any of the three other drug cue sets between the Non-Problem and Problem alcohol use groups: Marijuana, $F(1, 145) = 1.15$, ns; Crack Cocaine , $F(1, 145) = .18$, ns; Cigarettes, $F(1, 145) = .35$, ns.

Marijuana. Mean approach ratings for marijuana cues and the three other drug cue sets, with the participants grouped by recent marijuana use, are presented in Figure 5, third panel. As predicted, the multivariate Marijuana Use X Cue Type interaction was significant, $F(6, 290) = 12.16$, $p < .001$, $eta^2 = .20$. A follow up between-subjects ANOVA, with mean approach to each of the four cue types as the dependent variables, revealed that approach ratings increased as a function of marijuana use only for marijuana cues, $F(2, 147) = 32.83$, $p < .001$, $eta^2 = .31$; there were no significant group differences in approach ratings for the other three drug cue sets: Cigarettes, $F(2, 147) = .1.0$, ns; Alcohol, $F(2, 147) = .26$, ns; Crack Cocaine, $F(2, 147) = 4.1$, ns.

Crack Cocaine. Mean approach ratings for Crack Cocaine cues and the three other drug cue sets, with the participants grouped by recent crack cocaine use, are presented in Figure 5, fourth panel. As predicted, the multivariate Crack Cocaine Use X Cue Type interaction was significant, $F(3, 127) = 16.4$, $p < .001$, $eta^2 = .28$. Follow up between-subjects ANOVAs revealed that approach ratings increased as a function of crack cocaine use only for crack cocaine cues, $F(1, 47.65) = 21.12$, $p < .001$, $eta^2 = .22$; however, there were no significant group differences in approach ratings for the other three drug cue sets: Cigarettes, $F(1, 129) = .2.84$, ns.; Alcohol, $F(1, 129) = 2.93$, ns.; Marijuana, $F(1, 129) = 5.58$, ns.

Summary. Examination of the findings from the analysis of Approach reactivity to the four drugs, Cigarettes, Alcohol, Marijuana, and Crack Cocaine, shows support for the prediction that participants' level of approach reactivity increases as a function of their level of recent involvement with the substances. When participants were grouped according to their recent use of each of the four drugs, approach reactivity to the drugs increased significantly, whereas approach to the comparison cues and the other drug cues did not change significantly. This finding is consistent with the conceptualization of approach reactivity as an index of the intensity of recent drug-reward. Additionally, when participants were grouped according to their recent history of Cigarette use, Alcohol Use, Marijuana use, and Crack Cocaine use, comparisons of the relative levels of approach to matched drug cues versus approach to unmatched drug cues and non-drug comparison cues yielded potentially informative variability in approach reactivity patterns.

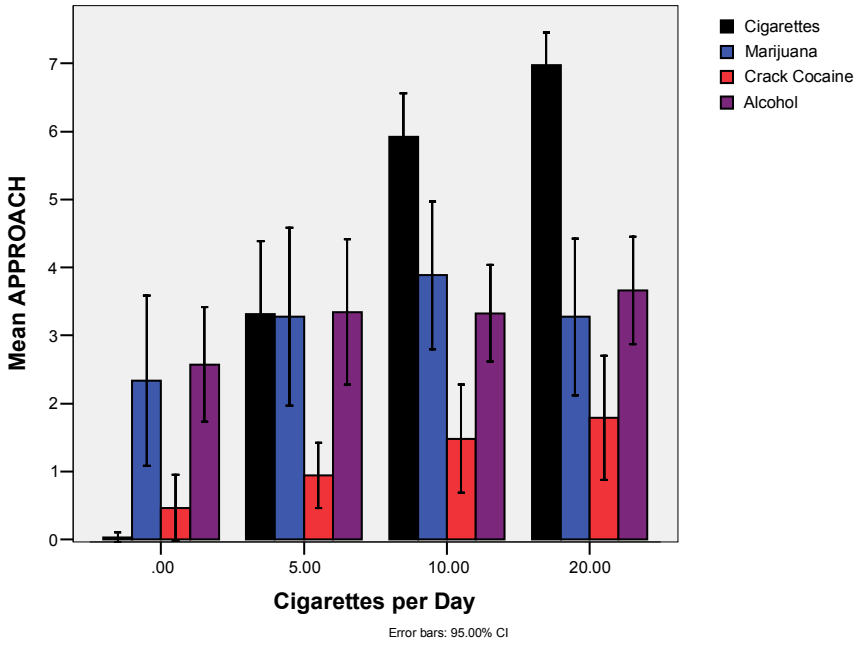
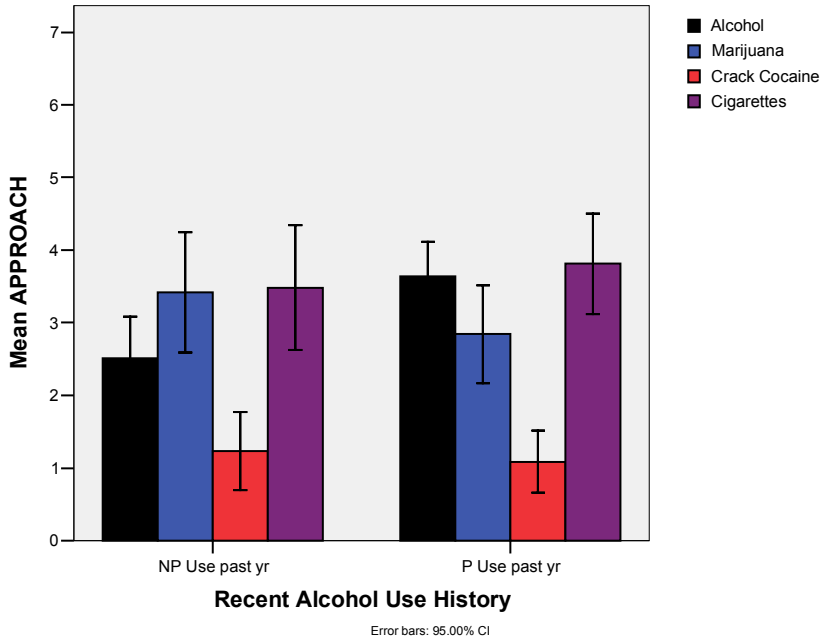


Figure 5: Approach - Drug vs. Other Drugs



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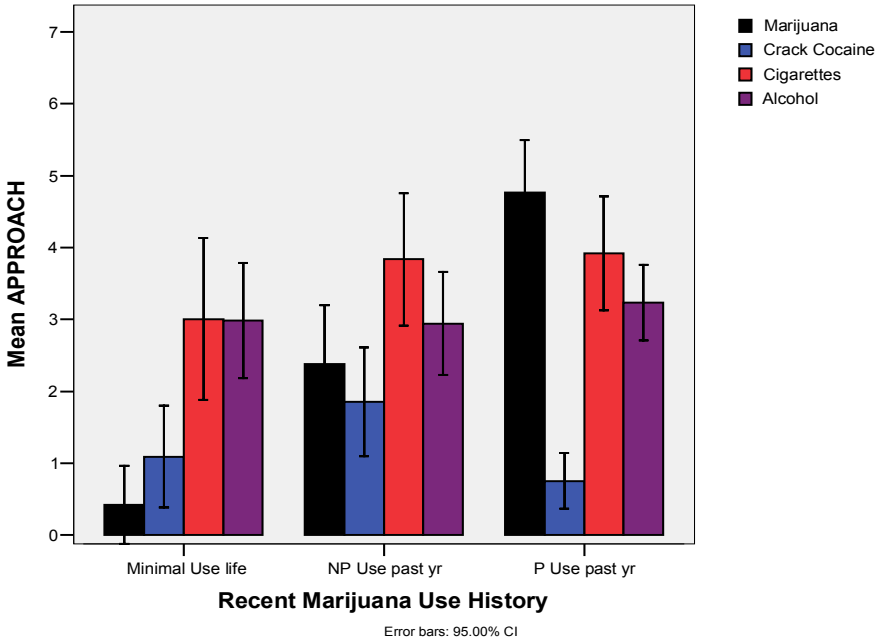

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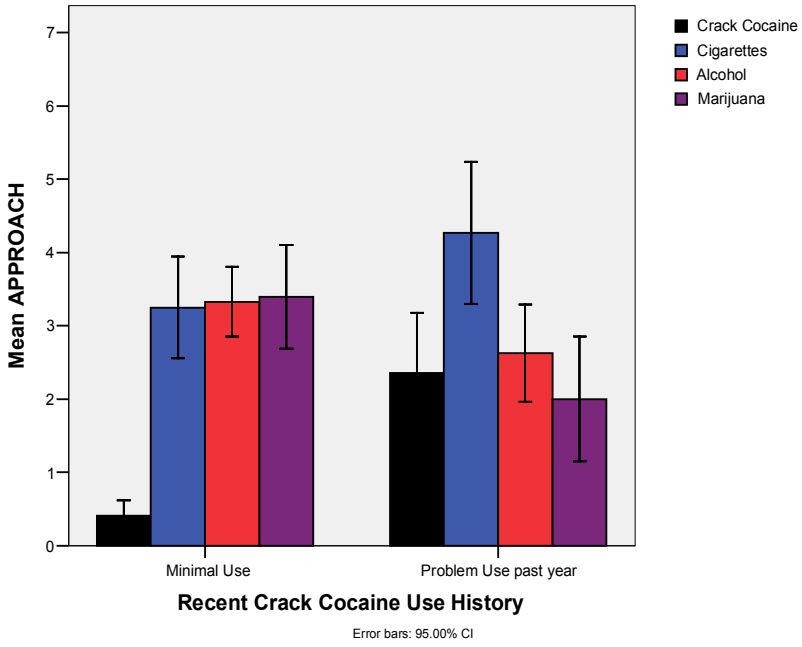


Figure 5: Continued.

Avoidance Reactivity as a Function of Recent Substance Use History

Avoidance Analyses Question 1: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to non-drug comparison cues?

Cigarettes. Mean avoidance ratings for cigarettes and the four comparison cue sets, with the participants grouped by current smoking status, are presented in Figure 6, first panel. As predicted, the multivariate Smoking Status X Cue Type interaction was significant for avoidance ratings, $F(12, 312.5) = 3.64$, $p < .001$, $eta^2 = .11$. A follow up univariate between-subjects ANOVA with avoidance ratings for each of the five cue types as the dependent variables showed that avoidance reactivity to cigarettes decreased significantly across the levels of the smoking status variable, $F(3, 103.4) = 19.79$, $p < .001$. Simple planned contrasts showed that mean avoidance to cigarettes did not decrease significantly between the Non Smokers and the Smokers who reported smoking 5 or fewer cigarettes per day, $t(50.76) = -2.2$, ns. Similarly, the difference in avoidance to cigarettes between 5 or fewer per day Smokers and 10 per day smokers was not significant, $t(48.7) = -2.19$, ns. However, the decrease in avoidance to cigarettes between the 10 per day Smokers and the 20 or more per day Smokers was significant, $t(66.84) = -2.92$, $p = .005$. Avoidance reactivity to the four sets of comparison cues did not differ across the levels of the smoking status variable: Unhealthy Food, $F(3, 121) = 2.84$, ns; Healthy Food, $F(3, 121) = .76$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(3, 121) = 2.39$, ns; Non-Alcoholic Caffeinated Beverages, $F(3, 121) = 1.96$, ns.

Alcohol. Mean avoidance ratings for Alcohol cues and the four comparison cue sets, with the participants grouped by recent alcohol use history, are presented in Figure 6, second panel. The multivariate Alcohol Use X Cue Type interaction was not significant, suggesting that avoidance reactivity to the Alcohol and comparison cue sets did not vary as a function of recent alcohol use history, $F(4, 142) = 1.28$, ns.

Marijuana. Mean avoidance ratings for Marijuana cues and the four comparison cue sets, with the participants grouped by recent marijuana use history, are presented in Figure 6, third panel. The multivariate Marijuana Use X Cue Type interaction was significant, $F(8, 288) = 4.88$, $p < .001$, $eta^2 = .12$. A follow up between-subjects ANOVA with avoidance ratings for each of the five cue types as the dependent variables showed that avoidance reactivity to Marijuana cues varied as a function of recent marijuana use history, $F(2, 92.92) = 18.25$, $p < .001$, $eta^2 = .20$. Simple contrasts showed that mean avoidance to Marijuana cues did not change significantly between the No / Minimal Use group and the Non-Problem Use group, $t(74.27) = -.53$, ns; however, avoidance to Marijuana cues decreased significantly between the Non-Problem Use and Problem Use group, $t(112.78) = -5.19$, $p < .001$. Mean avoidance ratings for the four comparison cue sets did not vary as a function of marijuana use history: Unhealthy Food, $F(2, 147) = 1.07$, ns; Healthy Food, $F(2, 147) = 2.35$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(2, 147) = .26$, ns; Non-Alcoholic Caffeinated Beverages, $F(2, 147) = .91$, ns.

Crack Cocaine. Mean avoidance ratings for Crack Cocaine cues and the four comparison cue sets, with the participants grouped by recent crack cocaine use history, are presented in Figure 6, fourth panel. The multivariate Crack Cocaine Use X Cue

Type interaction was not significant, F(4, 126) = .2, ns, indicating that avoidance reactivity to the Crack Cocaine cues and comparison cues did not vary as a function of recent crack cocaine use history.

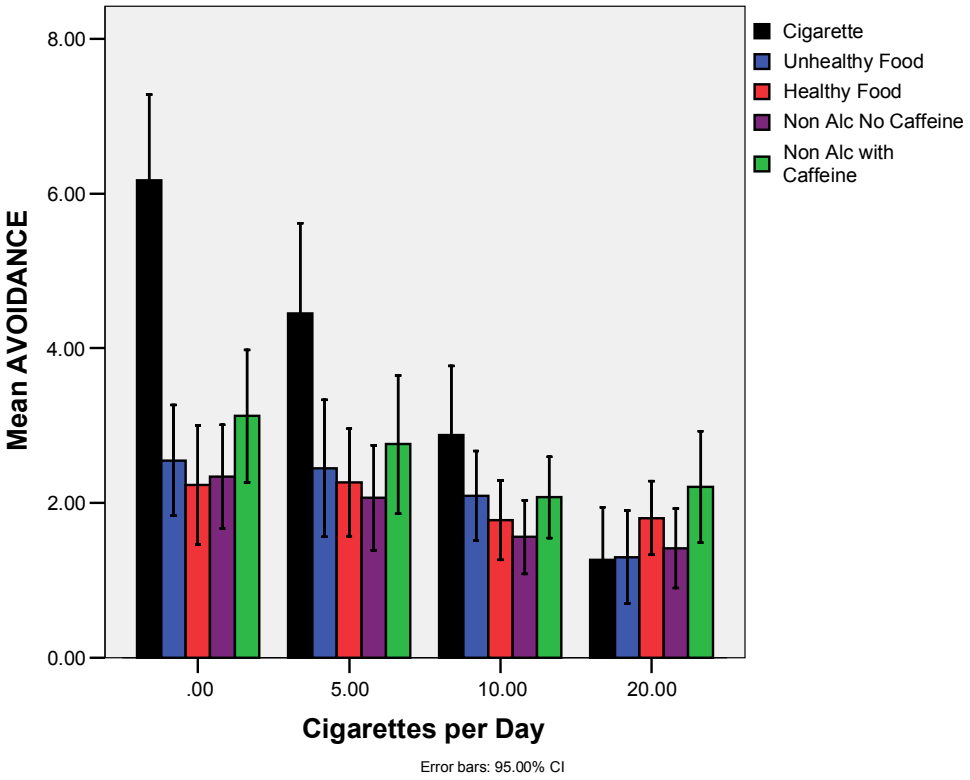


Figure 6: Avoidance - Drug vs. Comparison Cues

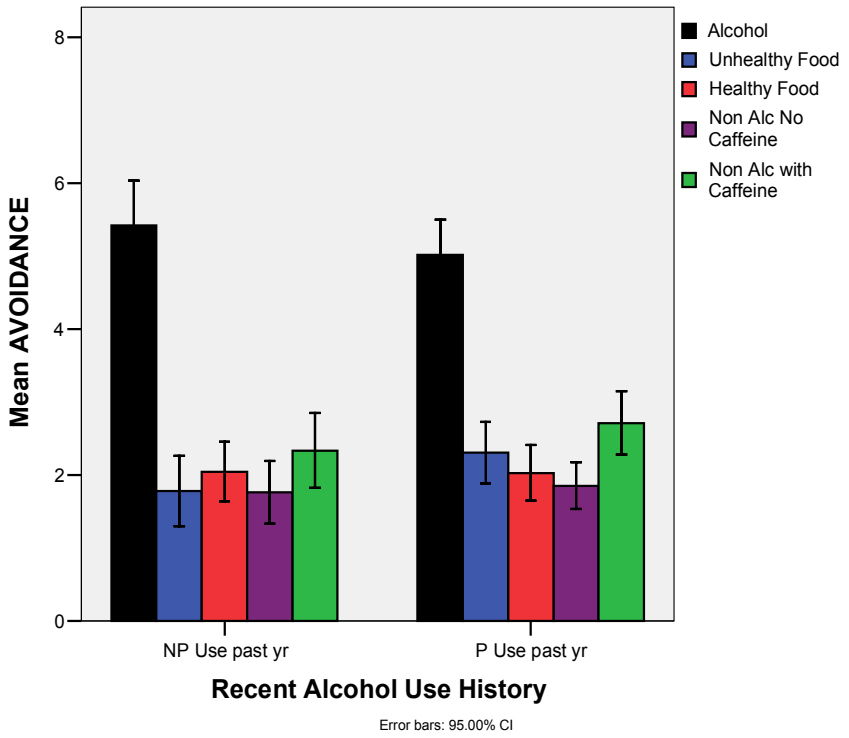
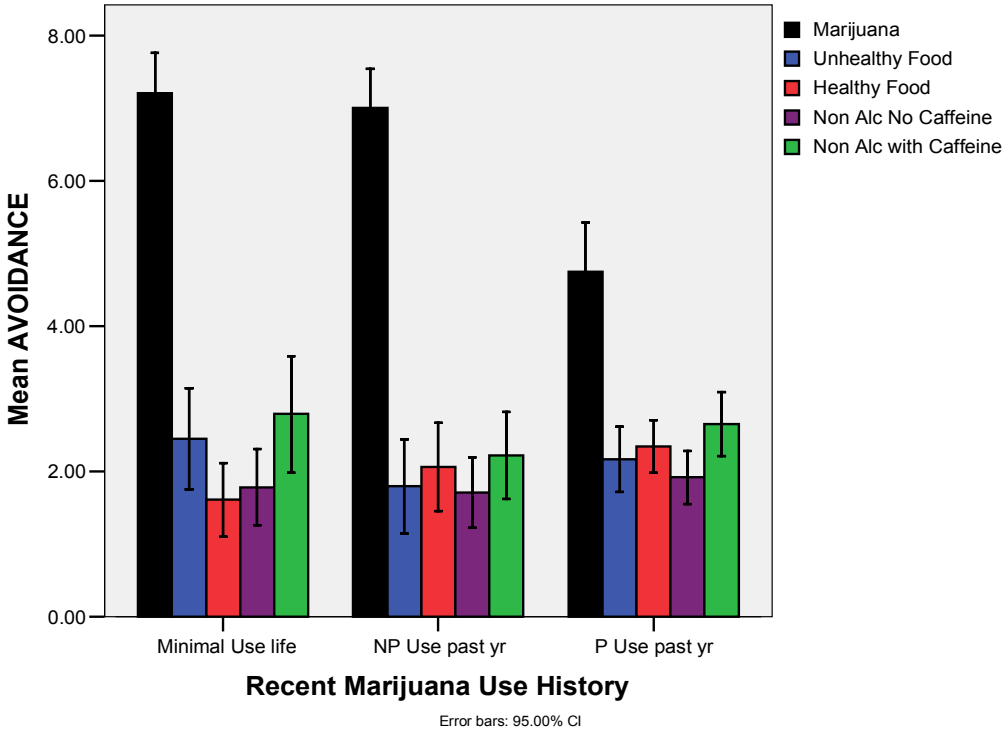


Figure 6: Continued



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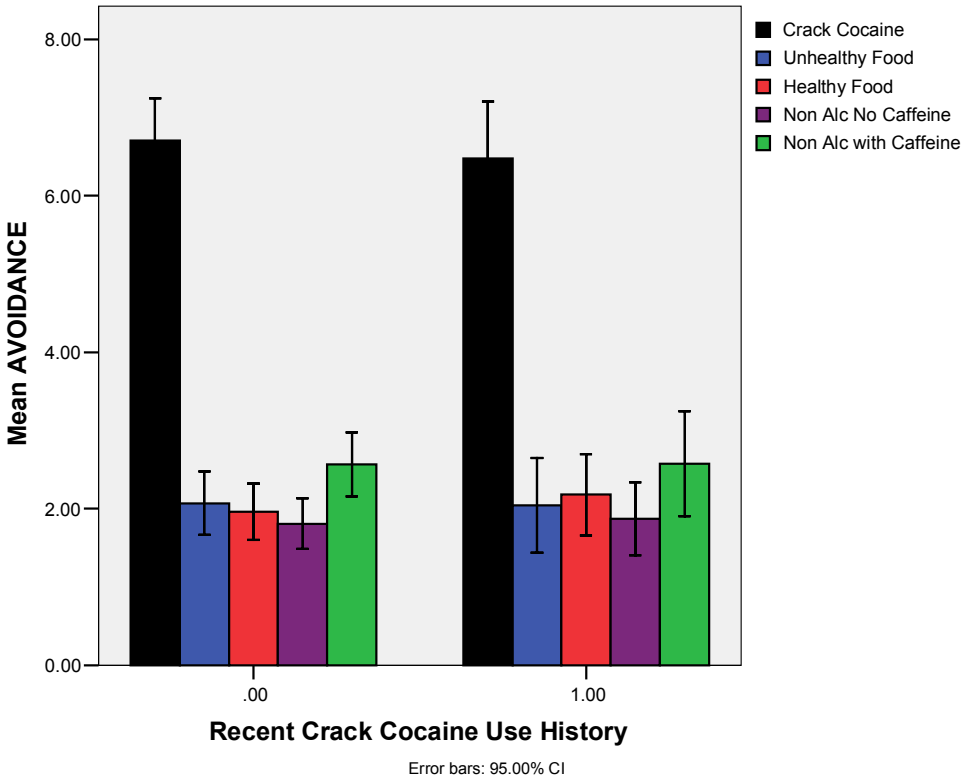


Figure 6: Continued.

Avoidance Analyses Question 2: When participants are grouped according to recent use of a specific drug, how does reactivity to cues for that drug relate to reactivity to non-drug comparison cues?

Cigarettes. For Non-Smokers, there was a significant main effect for cue type, $F(2.83, 82) = 26.3$, $p < .001$, $eta^2 = .48$. Simple contrasts showed that Non-Smokers' mean avoidance reactivity to the Cigarette cue set was significantly higher than their mean avoidance reactivity to each of the four comparison cue sets: Unhealthy Food, $F(1, 29) = 35.29$, $p < .001$, $eta^2 = .55$; Healthy Food, $F(1, 29) = 40.47$, $p < .001$, $eta^2 = .58$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 29) = 56.26$, $p < .001$, $eta^2 = .66$; and Non-Alcoholic Caffeinated Beverages, $F(1, 29) = 43.89$, $p < .001$, $eta^2 = .60$. For Smokers who reported smoking 5 or fewer cigarettes per day, there was a main effect for cue type, $F(2.94, 67.52) = 7.14$, $p < .001$, $eta^2 = .24$. Simple contrasts showed that 5 or fewer per day Smokers' mean avoidance to cigarette cues was significantly higher than their mean avoidance reactivity to each of the four comparison cue sets: Unhealthy

Food, F(1, 23) = 10.74, p = .003, eta^2 = .32; Healthy Food, F(1, 23) = 12.36, p = .002, eta^2 = .35; Non-Alcoholic Non-Caffeinated Beverages, F(1, 23) = 12.62, p = .002, eta^2 = .35; and Non-Alcoholic Caffeinated Beverages, F(1, 23) = 9.03, p = .006, eta^2 = .28. For 10 per day Smokers, the main effect for cue type was not significant, F(2.85,108.26) = 4.33, ns. Similarly, the main effect for cue type for 20 or more per day Smokers was not significant, F(3.35, 103.97) = 2.42, ns.

Alcohol. Because mean avoidance to the alcohol and comparison cue sets did not differ between Non-Problem and Problem alcohol users, the multivariate within-subjects contrasts from the original mixed-model MANOVA can be used to examine the differences between the whole sample's mean avoidance to Alcohol cues versus the comparison cue sets. There was a significant main effect for cue type F(2.78, 402.89) = 101.91 p < .001, eta^2 = .41. Simple contrasts showed that mean avoidance for the Alcohol cue set was significantly higher than mean avoidance for each of the comparison cue sets: Unhealthy Food, F(1, 145) = 166.47, p < .001, eta^2 = .53; Healthy Food, F(1, 145) = 160.94, p < .001, eta^2 = .53; Non-Alcoholic Non-Caffeinated Beverages, F(1, 145) = 188.94, p < .001, eta^2 = .57; and Non-Alcoholic Caffeinated Beverages, F(1, 145) = 115.91, p < .001, eta^2 = .44.

Marijuana. For No / Minimal Users, there was a significant main effect for cue type, F(3.35, 113,78) = 77.86, p < .001, eta^2 = .70. Simple contrasts showed that No / Minimal Users' mean avoidance reactivity to the Marijuana cue set was significantly higher than their mean reactivity to each of the four comparisons cue sets: Unhealthy Food, F(1, 34) = 103.7, p < .001, eta^2 = .75; Healthy Food, F(1, 34) = 205.56, p < .001, eta2 = .86; Non-Alcoholic Non-Caffeinated Beverages, F(1, 34) = 191.21, p < .001, eta^2 = .85; and Non-Alcoholic Caffeinated Beverages, F(1, 34) = 85.58, p < .001, eta^2 = .72. Non-Problem Users' mean avoidance reactivity to the Marijuana cue set was also significantly higher than their mean reactivity to each of the four comparisons cue sets: Unhealthy Food, F(1, 41) = 187.3, p < .001, eta^2 = .82; Healthy Food, F(1, 41) = 134.01, p < .001, eta^2 = .77; Non-Alcoholic Non-Caffeinated Beverages, F(1, 41) = 249.57, p < .001, eta^2 = .86; and Non-Alcoholic Caffeinated Beverages, F(1, 41) = 144.71, p < .001, eta^2 = .78. Problem Users' mean avoidance reactivity to the Marijuana cues was significantly higher than their mean reactivity to the four comparison cue sets: Unhealthy Food, F(1, 72) = 49.6, p < .001, eta^2 = .41; Healthy Food, F(1, 72) = 34.7, p < .001, eta^2 = .33; Non-Alcoholic Non-Caffeinated Beverages, F(1, 72) = 45.48, p < .001, eta2 = .39; and Non-Alcoholic Caffeinated Beverages, F(1, 72) = 26.41, p < .001, eta^2 = .27. The magnitude of the difference was smaller for the Problem Users than it was for the Non-Problem Users and No / Minimal Users.

Crack Cocaine. Because mean avoidance to the Crack Cocaine and comparison cue sets did not differ between No / Minimal and Problem crack cocaine users, the multivariate within-subjects contrasts from the original mixed-model MANOVA can be used to examine the differences between the whole sample's mean avoidance to Crack Cocaine cues versus the comparison cue sets. There was a significant main effect for cue type F(2.54, 327.44) = 150.11, p < .001, eta^2 = .54. Simple contrasts showed that mean avoidance for the Crack Cocaine cue set was significantly higher than mean avoidance for each of the comparison cue sets: Unhealthy Food, F(1, 129) = 199.29, p < .001, eta^2 = .61; Healthy Food, F(1, 129) = 236.4, p < .001, eta^2 = .65; Non-Alcoholic

Non-Caffeinated Beverages, $F(1, 129) = 283.1$, $p < .001$, $eta^2 = .69$; and Non-Alcoholic Caffeinated Beverages, $F(1, 129) = 187.5$, $p < .001$, $eta^2 = .59$.

Avoidance Analyses Question 3: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to other drug cues?

Cigarettes. Mean avoidance ratings for cigarettes and the four other three drug cue sets, with the participants grouped by current smoking status, are presented in Figure 7, first panel. As predicted, the multivariate Smoking Status X Cue Type interaction was significant, $F(9, 289.77) = 7.02$, $p < .001$, $eta^2 = .15$. A follow up between-subjects ANOVA with avoidance ratings for each of the four cue types as the dependent variables showed that avoidance reactivity to cigarettes decreased significantly across the levels of the smoking status variable, $F(3, 103.45) = 19.79$, $p < .001$, $eta^2 = .33$. Simple contrasts revealed that avoidance to cigarettes did not decrease significantly between Non-Smokers and 5 or fewer per day Smokers, $t(50.76) = -2.2$, ns, or between 5 or fewer per day Smokers and 10 per day Smokers, $t(48.7) = -2.19$, ns. Avoidance to cigarettes did decrease significantly between 10 per day Smokers and 20 or more per day Smokers, $t(66.84) = -2.92$, $p = .005$. Avoidance reactivity to the other three drug cue sets did not differ across the levels of the smoking status variable: Alcohol, $F(3, 121) = .14$, ns; Marijuana, $F(3, 121) = .06$, ns; Crack Cocaine, $F(3, 95.63) = 1.57$, ns.

Alcohol. Mean avoidance ratings for Alcohol cues and the other three drug cue sets, with the participants grouped by recent alcohol use history, are presented in Figure 7, second panel. The multivariate Alcohol Use X Cue Type interaction was not significant, suggesting that avoidance reactivity to the Alcohol and other drug cue sets did not vary as a function of recent alcohol use history, $F(3, 143) = .13$, ns.

Marijuana. Mean avoidance ratings for Marijuana cues and the other three drug cue sets, with participants grouped by recent marijuana use history, are presented in Figure 7, third panel. As predicted, the multivariate Marijuana Use X Cue Type interaction was significant, $F(6, 290) = .006$, $p = .006$, $eta^2 = .06$. A follow up between-subjects ANOVA with avoidance ratings for each of the four cue types as the dependent variables revealed that avoidance reactivity to Marijuana cues varied significantly as a function of recent marijuana use history $F(2, 92.92) = 18.25$, $p < .001$, $eta^2 = .20$. Avoidance reactivity did not vary as a function of Marijuana Use for the other three drug cue sets: Crack Cocaine, $F(2, 84.85) = 2.44$, ns; Cigarettes, $F(2, 147) = 2.01$, ns; Alcohol $F(2, 147) = 3.45$, ns.

Crack Cocaine. Mean avoidance ratings for Crack Cocaine cues and the other three drug cue sets, with the participants grouped by recent crack cocaine use history, are presented in Figure 7, fourth panel. The multivariate Crack Cocaine Use X Cue Type interaction was significant, $F(3, 127) = 3.17$, $p = .03$, $eta^2 = .07$. However, a follow up between-subjects ANOVA with avoidance ratings for each of the four cue types as the dependent variables revealed that avoidance ratings did not vary significantly for any of the four drug cue types as a function of recent crack cocaine use: Crack Cocaine, $F(1, 129) = .253$, ns; Cigarettes, $F(1, 93.57) =$ ns; Alcohol, $F(1, 129) = 1.87$, ns; Marijuana, $F(1, 129), = .77$, ns.

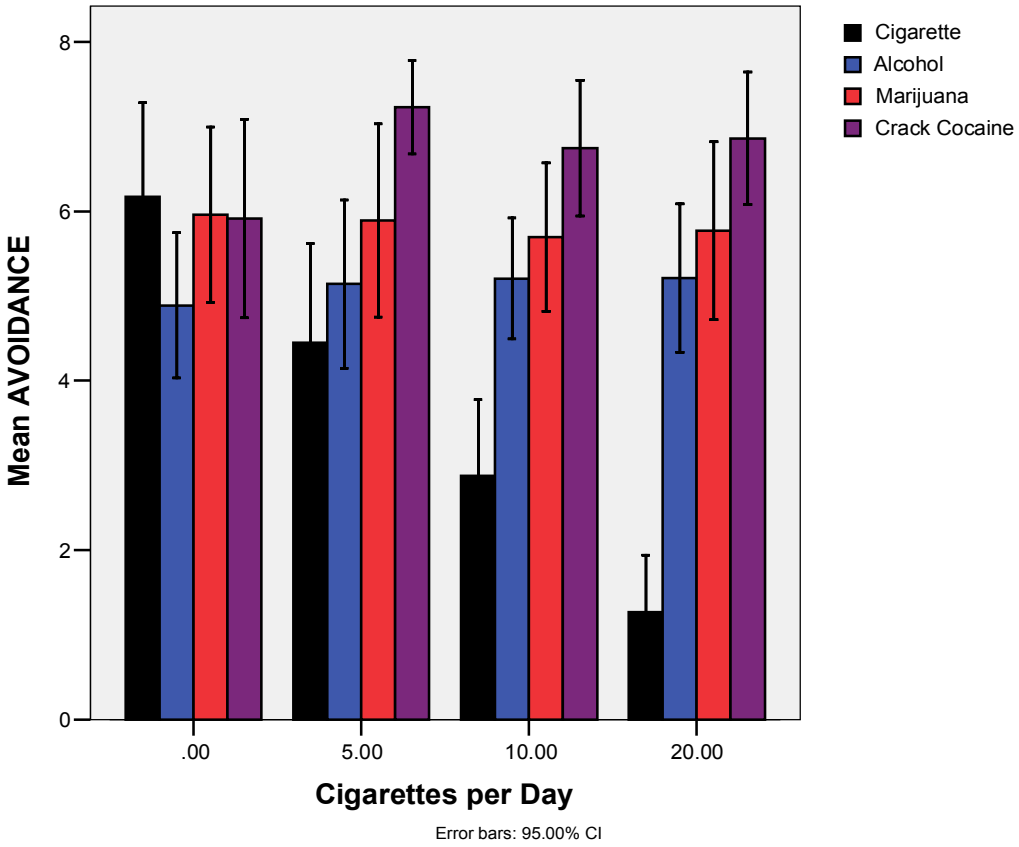
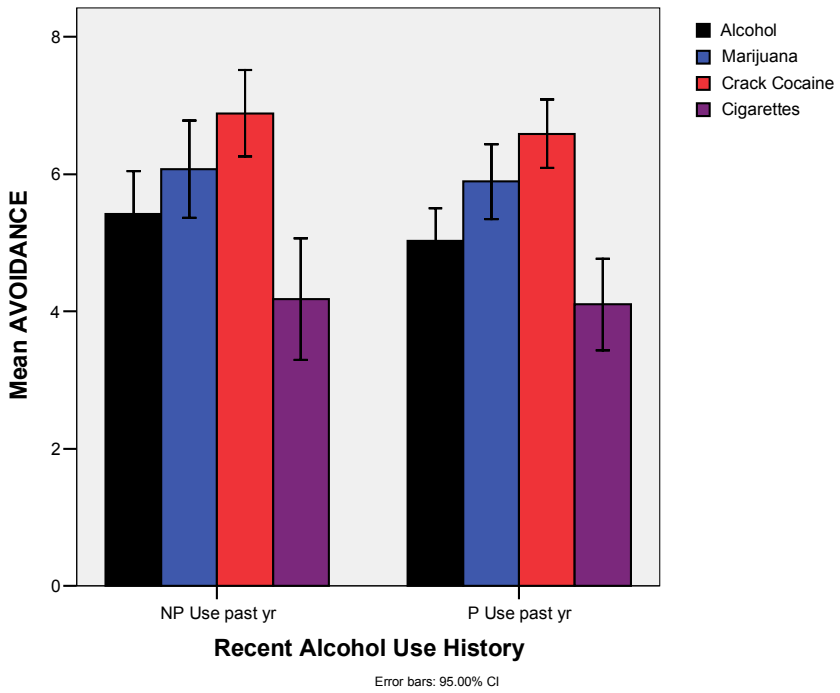


Figure 7: Avoidance - Drug vs. Other Drugs



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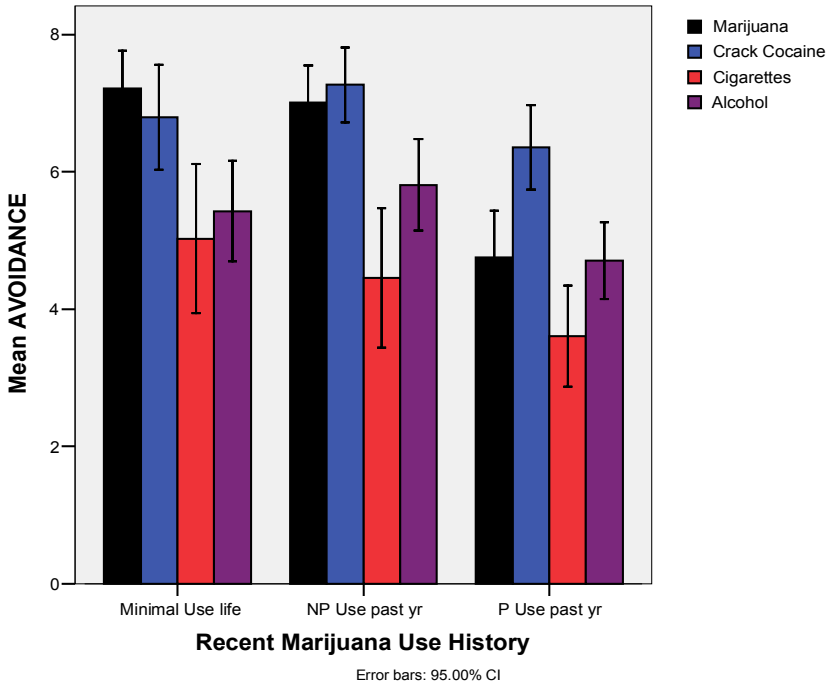

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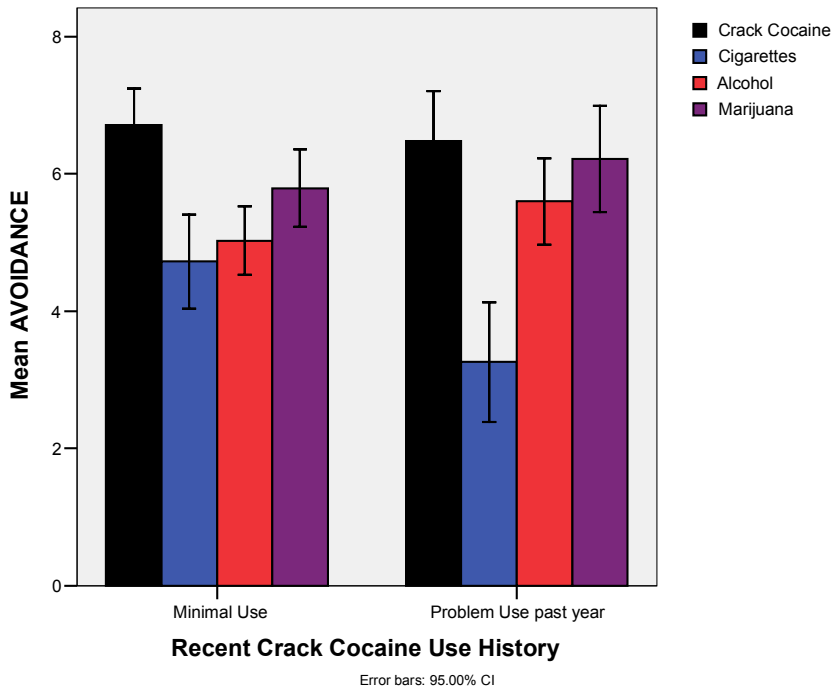

Figure 7: Continued.

Summary. Examination of the findings from the analysis of Avoidance reactivity to the Cigarette and Marijuana cues shows support for the prediction that participants' level of avoidance reactivity varies as a function of their level of recent involvement with the substances. When participants were grouped according to their current cigarette smoking status, avoidance to cigarettes generally decreased as the number of cigarettes smoked per day increased. The decrease in avoidance between Smokers who reported smoking 10 cigarettes per day and Smokers who reported smoking 20 cigarettes per day was significant. Furthermore, smokers who reported smoking either 10 cigarettes per day or more than 20 cigarettes per day exhibited avoidance to cigarette cues that was as low as their avoidance to the non-drug comparison cues, and much lower than their avoidance to the other three drugs. The pattern of avoidance to cigarette cues among participants in the present study illustrates the expected pattern of avoidance to a drug when groups are formed solely on the basis of quantity and frequency of use.

Examination of avoidance to marijuana cues reveals a different type of reactivity pattern. In this case, non users and non-problem users both showed a high level of avoidance to marijuana cues, whereas the problem users showed a significantly lower level of avoidance. Yet, problem users' avoidance to marijuana cues was relatively high in comparison to their avoidance to the non-drug comparison cues. In contrast to the

findings for Cigarette and Marijuana cues, Avoidance reactivity for the Crack Cocaine cues and Alcohol cues was not different across the levels of the drug use history grouping variables. The lack of variation in avoidance for Alcohol cues may be a function of the similarities between the non-problem and problem drinkers in our sample. The relatively high level of avoidance toward crack cocaine reported by the Problem Use group, in comparison to the level of avoidance to marijuana displayed by the problem marijuana users, may reflect a fundamental difference between the two drugs in terms of the rate of accumulation and severity of the negative consequences of use.

Relationship Between Multidimensional 'Reactivity Space' and Recent Drug Use

As outlined in the hypotheses, our third exploration of the approach and avoidance reactivity dimensions involved examination of the relationship between participants' recent drug use and the "reactivity space" created by placing Approach and Avoidance reactivity on orthogonal axes. Earlier, we pointed out that for each drug, individual respondents can be found in all four quadrants: Approach, Avoidant, Indifferent, and Ambivalent. For marijuana cues, the Indifferent quadrant was relatively sparsely populated, as was the Approach quadrant for crack cocaine cues; for cigarette and alcohol cues the dispersion across the quadrants was somewhat more balanced.

If membership in each quadrant truly means what we have posited (i.e., low approach / low avoidant responders are "indifferent to the drug", etc.), then there should be clinically meaningful differences between the respondents in each quadrant for any given drug, and, there should be clinically meaningful similarities between the members of corresponding quadrants across the four drugs.

To assess this prediction, each of the four drug use history grouping variables was cross-tabulated with the reactivity space profile for the matched drug cue set. Table 6 shows the results of these cross-tabulations. (Note that for this analysis, the levels that were dropped from the grouping variables because they contained a small number of participants were returned because small cell size was not an issue.) As predicted, reactivity quadrant membership was clearly related to use history, and some similar patterns emerged across the four drug cue sets. For all four drug cue sets, the majority of No / Minimal Users fell into the Avoidant quadrant (67% to 91%), with nearly all the remainder falling into the Indifferent quadrant (3% to 33%). Similarly, for Alcohol, Marijuana, and Crack Cocaine, a large segment of the Non-Problem Users also fell into the Avoidant quadrant, with percentages ranging from 66 to 76. However, the remaining Non-Problem crack cocaine users and marijuana users fell into the Approach and Ambivalent quadrants, whereas the rest of the Non-Problem alcohol users were spread across all three quadrants. Forty-one percent of cigarettes smokers who reported smoking 5 or fewer cigarettes per day fell into the Avoidant quadrant, vs. only five percent of the 10 per day smokers, and none of the 20 or more per day smokers. In contrast, 26 percent of the 10 per day smokers fell into the Ambivalent quadrant, whereas only a few of the 5 or fewer and 20 or more smokers fell into the Ambivalent quadrant (eight and nine percent, respectively).

In stark contrast to the No / Minimal and Non Problem use groups, relatively few of the respondents in the Problem Use alcohol, marijuana, and crack cocaine groups fell into the Indifferent quadrant (7% to 13%). Considerably higher percentages of the Problem Use groups were found in the Ambivalent quadrant, ranging from 17 to 30 percent. The percentages of Problem Users in the Approach and Avoidance quadrants varied considerably across the four drug cue sets. This spread across the Avoidant, Approach, and Ambivalent quadrants can be interpreted as reflective of the expected differences among the Problem users in their current positions along the stage of change continuum.

Table 6: Cross Tabulation of Recent Drug Use History by Reactivity Space

Drug	Reactivity Space for Specified Drug				
	Indifferent	Avoidant	Approach	Ambivalent	Total
Alcohol					
No/Minimal use	2 (33.3%)	4 (66.7%)	0 (0.0%)	0 (0.0%)	6 (100.0%)
Non-problem use past year	8 (13.8%)	38 (65.5%)	8 (13.8%)	4 (6.9%)	58 (100.0%)
Problem use past year	12 (13.5%)	37 (41.6%)	18 (20.2%)	22 (24.7%)	89 (100.0%)
Total	22 (14.4%)	79 (51.6%)	26 (17.0%)	26 (17.0%)	153 (100.0%)
Marijuana					
No/Minimal use	1 (2.9%)	32 (91.4%)	0 (0.0%)	2 (5.7%)	32 (100.0%)
Non-problem use past year	0 (0.0%)	31 (75.6%)	2 (4.9%)	8 (19.5%)	41 (100.0%)
Problem use past year	5 (7.1%)	20 (28.6%)	24 (34.3%)	21 (30.0%)	70 (100.0%)
Total	6 (4.1%)	83 (56.8%)	26 (17.8%)	31 (21.2%)	146 (100.0%)
Crack Cocaine					
No/Minimal use	13 (14.9%)	72 (82.8%)	0 (0.0%)	2 (2.3%)	87 (100.0%)
Non-problem use past year	0 (0.0%)	11 (73.3%)	2 (13.3%)	2 (13.3%)	15 (100.0%)
Problem use past year	7 (16.7%)	25 (59.5%)	2 (4.8%)	8 (19.0%)	42 (100.0%)
Total	20 (13.9%)	108 (75.0%)	4 (2.8%)	12 (8.3%)	144 (100.0%)
Cigarettes					

Table 6-continued.

Drug	Reactivity Space for Specified Drug				
	Indifferent	Avoidant	Approach	Ambivalent	Total
Non-Smokers	5 (16.7%)	25 (83.3%)	0 (0.0%)	0 (0.0%)	30 (100.0%)
5 Cigarettes per day	4 (16.7%)	10 (41.7%)	8 (33.3%)	2 (8.3%)	24 (100.0%)
10 Cigarettes per day	5 (12.8%)	2 (5.1%)	22 (56.4%)	10 (25.6%)	39 (100.0%)
20 Cigarettes per day	1 (3.1%)	0 (0.0%)	28 (87.5%)	3 (9.4%)	32 (100.0%)
Total	15 (12.0%)	37 (29.6%)	58 (46.4%)	15 (12.0%)	125 (100.0%)

Further exploration of the reactivity space / cigarette use relationship was undertaken by removing non-smokers from the sample, and comparing the remaining participants' mean scores on the three subscales of the SOCRATES index of smoking change motivation when participants were grouped according to membership in the four reactivity space quadrants (see Figure 8). A repeated measures MANOVA with reactivity space quadrant as the between-subjects factor and scale score as the within-subjects factor revealed a significant multivariate Quadrant X Scale Score interaction, $F(3, 44.87) = 23.92$, $p = < .001$. Follow up analyses revealed that the mean score on the SOCRATES Ambivalence scale was significantly higher for the Ambivalent Quadrant than for the Approach Quadrant, $t(42.11) = 2.93$, $p = .005$. A similar analysis conducted with recent non-problem and problem marijuana users also revealed a significant multivariate Quadrant X Scale Score interaction, $F(2, 99) = 18.61$, $p = < .001$. (See Figure 9; for this analysis, the Indifferent Quadrant was left out because it contained a very small number of participants.) Follow up analyses targeting the differences between the Approach and Ambivalent Quadrants revealed that the mean score on SOCRATES Problem Recognition was significantly higher in the Ambivalent Quadrant than in the Approach Quadrant, $t(99) = 2.41$, $p = .018$. Taken together, these findings support our conceptualization of the clinical differences between these two quadrants.

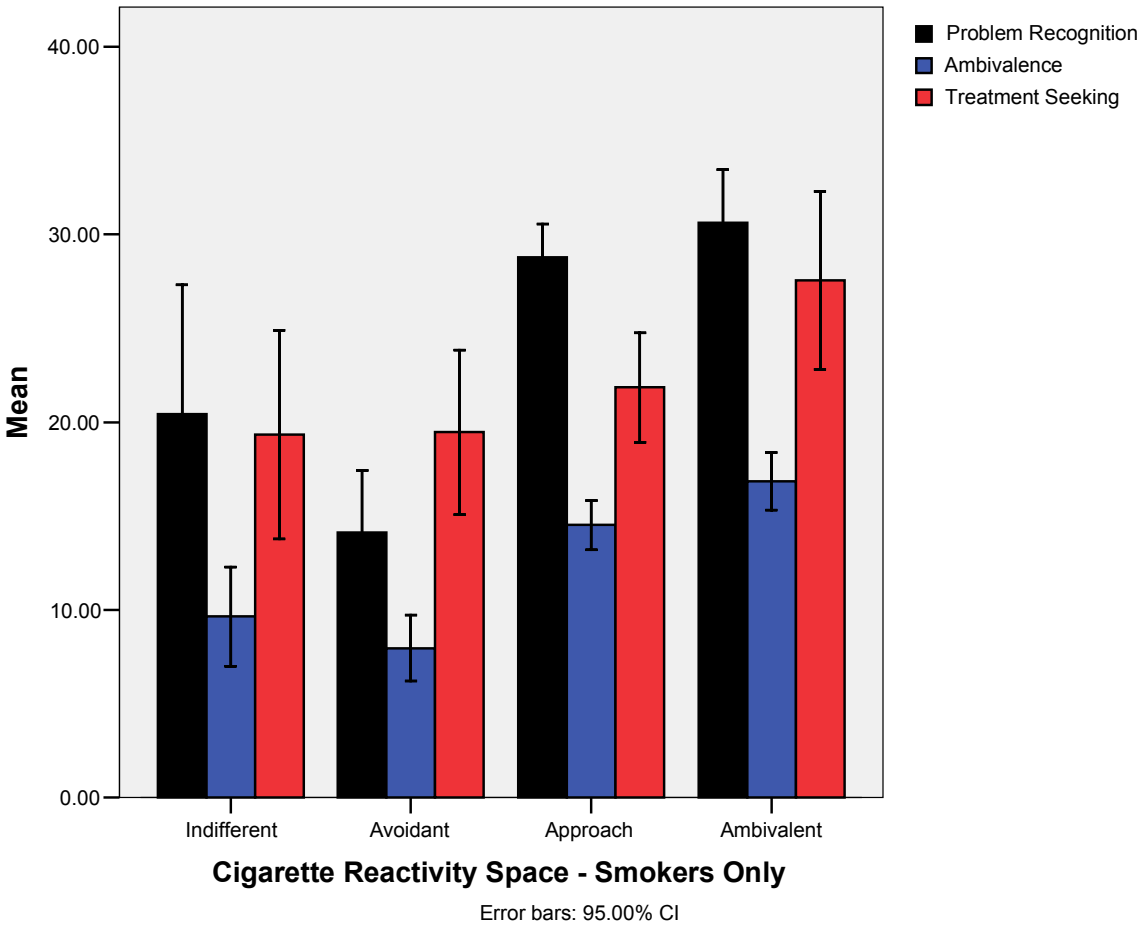

Figure 8: SOCRATES-Cigarette Scale Scores By Cigarette Reactivity Space

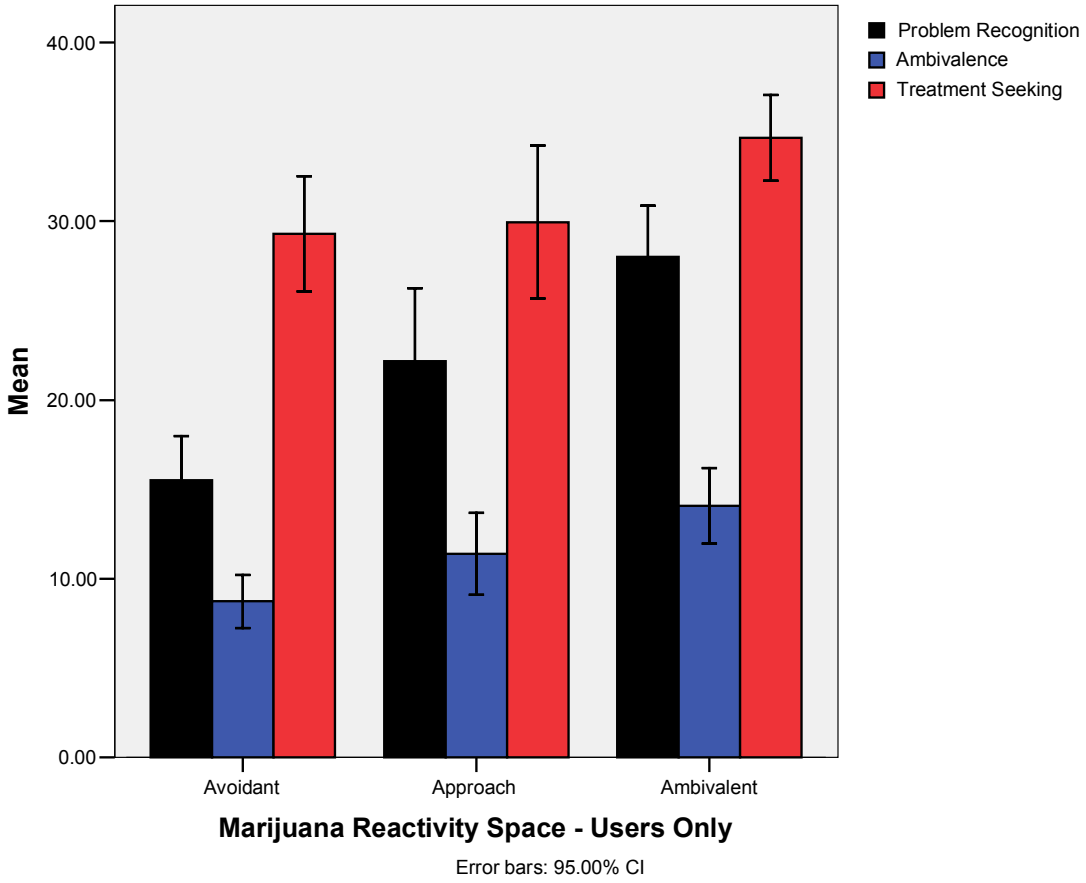

Figure 9: SOCRATES-Marijuana Scores By Marijuana Reactivity Space

Relationship Between Approach and Avoidance Reactivity and Measures of Substance-Relevant Constructs

After examining the relationship between the substance use constructs and participant's recent use history of the four drugs, we subsequently attempted to utilize the substance use constructs to establish criterion validation for our four drug cue sets. This was accomplished by examining the relationship between the Approach and Avoidance reactivity ratings for each of the drug cue sets and the individual difference measures assessing various aspects of substance use. We predicted that the Approach ratings would be related to most of the substance-related individual difference measures, much like the "craving" index used in many previous substance cue reactivity

studies. Additionally, we predicted that the Avoidance ratings would contribute uniquely to at least some of the measures, in support of the assertion that Avoidance represents a separate reactivity dimension, which yields additional information that can't be captured when only Approach is measured.

To assess these potential relationships, a series of separate regression analyses were performed, in which each measure's total score and its scale scores were regressed simultaneously on the Approach and Avoidance ratings. The No / Minimal Use subgroup in each drug use history grouping variable was removed from the sample when analyses of the matched drug were conducted. Table 7 shows the results of these analyses for each of the four drug cue categories. As predicted, Approach ratings were significantly correlated with most of the measures in each drug category. Also as expected, on some measures both Approach and Avoidance ratings contributed significantly to the overall prediction model. Additionally, Avoidance was significantly related to several measures with which Approach showed no significant relationship. Note that Bonferroni alpha corrections were applied to analyses conducted on measures with more than one scale.

Table 7: Regression Coefficients from Regressions of Substance Use Measures on Approach and Avoidance Ratings

Substance and Measure	**Approach Beta**	**Avoidance Beta**	**Overall Model R^2**
Alcohol			
CAGE	0.37*	0.20*	0.11*
SMAST	0.26**	0.13	0.05*
DMQ Total	0.55*	0.15	0.25*
Social	0.55**	0.11	0.26*
Coping	0.48**	0.10	0.20*
Enhancement	0.61**	0.18	0.30*
Conformity	0.19	0.12	0.03
SOCRATES Total	0.52*	0.21*	0.20*
Problem Recognition	0.47**	0.16	0.17*
Ambivalence	0.41**	0.19	0.13*
Treatment Seeking	0.41**	0.20	0.13*
AEI Total	0.48*	0.22*	0.18*
Positive	0.50**	0.21	0.20*
Negative	0.41**	0.16	0.13*
Arousal	0.52**	0.14	0.22*
Sedation	0.27**	0.18	0.06*
AASE-T Total	0.60*	0.05	0.33*
Craving	0.54**	0.07	0.27*
Physical Concerns	0.43**	-0.03	0.20*
Social/Positive	0.64**	0.10	0.36*
Negative Affect	0.55**	0.04	0.28*

Table 7-continued.

Substance and Measure	Approach Beta	Avoidance Beta	Overall Model R^2
AASE-C Total	-0.15	-0.04	0.03
Craving	-0.13	0.01	0.02
Physical Concerns	-0.03	0.08	0.01
Social/Positive	-0.24**	0.03	0.07*
Negative Affect	-0.15	0.04	0.03
Cigarettes			
SOCRATES Total	0.24	0.26	0.05
Problem Recognition	0.40**	0.07	0.14*
Ambivalence	0.40**	0.19	0.12*
Treatment Seeking	-0.05	0.26	0.08*
SEQ-12 Total	-0.17	0.37*	0.23*
Internal Stimuli	-0.18	0.39**	0.26*
External Stimuli	-0.13	0.33**	0.17*
SMQ Total	0.47*	0.14	0.18*
Social	0.39**	0.26	0.12*
Coping	0.47**	0.06	0.20*
Enhancement	0.42**	-0.05	0.20*
Conformity	0.13	0.19	0.03
QSU Total	0.80*	-0.02	0.66*
Need	0.61**	0.03	0.35*
Want	0.62**	0.01	0.38*
Marijuana			
SOCRATES Total	0.42*	0.14	0.14*
Problem Recognition	0.52**	0.14	0.22*
Ambivalence	0.37**	0.09	0.12*
Treatment Seeking	0.20	0.12	0.03
MMQ Total	0.27*	-0.16	0.14*
Social	0.19	-0.22	0.13*
Coping	0.24	-0.16	0.12*
Enhancement	0.44**	-0.04	0.21*
Conformity	-0.11	-0.01	0.01
Experiential	0.16	-0.17	0.08*
MCQ Total	0.38*	-0.24*	0.30*
Urges	0.40**	-0.16	0.25*
Intent to Use	0.23	-0.24	0.17*
Positive Outcome	0.42**	-0.22	0.31*
Relief Negative	0.31**	-0.28**	0.26*
Lack of Control	0.32**	-0.21	0.21*
Cocaine			
SOCRATES Total	0.37*	-0.02	0.13
Problem Recognition	0.39**	0.06	0.15*
Ambivalence	0.46**	0.01	0.21*
Treatment Seeking	0.13	-0.12	0.03
CCQ Total	0.29	-0.08	0.09
Desire to Use	0.26	0.01	0.07

Table 7-continued.

Substance and Measure	Approach Beta	Avoidance Beta	Overall Model R^2
Intention and Planning	0.18	-0.11	0.03
Anticipation of Positive Outcome	0.21	-0.12	-0.06
Anticipation of Relief from Withdrawal or Dysphoria	-0.12	-0.06	0.02
Lack of Control	0.52**	-0.13	0.29*
CEQ-P Total	0.38*	-0.36*	0.27
Positive Total	0.36**	-0.31**	0.22
Negative Total	0.27**	-0.35**	0.20
Well-Being Enhancement	0.24	-0.26	0.13
Sexual Enhancement	0.21	-0.17	0.07
Pain Reduction	0.35	-0.36	0.25*
Increased Aggression	0.39**	-0.27	0.22*
Social Facilitation	0.26	-0.21	0.11
Social Withdrawal	0.33	-0.29	0.19*
Increased Tension	0.15	-0.34	0.13

* Significant at .05 - used for Overall Model tests, and tests of Approach and Avoidance on Total Scores and/or instruments with only one scale.
** Significant with Bonferroni alpha correction – used for instruments with multiple scales.

Manipulation of Cigarette Availability Between Sessions

Our final hypothesis concerned the impact of manipulating the availability of cigarettes between the first two study sessions. We predicted that cigarette smokers' arousal and avoidance reactivity would be significantly lower in the "Smoking Permitted" cue exposure and rating session that in the "Smoking Not Permitted" cue exposure and rating session, whereas approach ratings would not differ between the two sessions. To test this hypothesis, we grouped participants were grouped by number of cigarettes smoked per day, and compared the three reactivity indices across the two sessions. A doubly repeated measures MANOVA with cigarettes per day as the between-subjects factor and ratings and session as the within-subjects factors was not significant, $F(12, 280) = 2.62$, ns, indicating that there was no significant differences on any of the three ratings across the two sessions. As such, we concluded that the availability manipulation failed.

DISCUSSION

The objective of the present study was to test the ability of our newly modified cue exposure methodology to gather meaningful information about the substance cue reactivity of women substance abusers during incarceration. With this study, we aimed to further validate the utility of our model of substance cue reactivity, which is based on the idea that measuring approach and avoidance inclination as separate, orthogonal dimension yields a more informative and potentially useful characterization of reactivity than the measurement of approach inclination alone. This study simultaneously extended the methodology to a clinical population *and* a novel context, and also added two new psychoactive substances, marijuana and crack cocaine, to the categories subjected to evaluation. To accomplish this objective, six hypotheses were evaluated.

Sample Characteristics and Validation of Recent Use History

The first step in the analytic process was to break the sample down by recent use history for each of the four substances of interest: alcohol, cigarettes, marijuana, and crack cocaine. What becomes immediately apparent in this grouping process is the fact that these four drugs are distinct from one another in ways that go well beyond the differences in their psychoactive properties. Differences among these drugs in terms of social factors such as legality, consequences of use, accessibility, prevalence, and degree of integration into society combine and interact with the significant variations in psychoactive properties to the extent that the overall experience associated with use of each of these four drugs is essentially unique. A full comparison of the implications surrounding use of each of these drugs is beyond the scope of the present discussion. However, it is important to note that these drugs do differ from one another, and further, that all of the analyses undertaken in the present study need to be interpreted with these differences in mind.

Because the primary focus of this investigation is the multidimensional substance cue reactivity that purportedly develops as a result of the repeated exposure to positive and negative consequences of substance use, it made sense to try to divide our sample based on the consequences of use. For alcohol, marijuana, and crack cocaine, the initial plan was to group participants in terms of the nature of their recent use of each drug; that is, those who have used the drug not at all or minimally, those who have used the drug regularly but in the absence a diagnosable use disorder, and those who used

the drug regularly in a manner that met criteria for abuse or dependence. The main distinction between the latter two categories is that disordered users have crossed a threshold in terms of the accumulation of negative consequences of their substance use.

Having these three groups to compare for each drug would have been ideal, but for various reasons some of these groups were not present in our sample. Among our sample of substance abusers in treatment, we did not find very many non-problem crack cocaine users, nor did we find many individuals who reported using alcohol minimally or not at all. We conclude that this is probably not an idiosyncrasy of our sample, but rather is reflective of this type of sample (substance abusers in treatment) and of the unique characteristics of alcohol and crack cocaine.

The fourth drug under investigation in this study was tobacco cigarettes. It's difficult to characterize cigarette use as "non-problematic" vs. "problematic". On one hand, one could argue that all cigarette use is problematic, because of the known negative health effects associated with cigarette smoking. On the other hand, one could argue that all cigarette use is non-problematic until such time as an actual adverse health effect has been detected and its impact felt by the smoker. Also, because cigarettes aren't illegal and don't produce the kind of cognitive and emotional effects that the other drugs produce, cigarettes are rarely associated with the adverse legal and social consequences that can be associated with use of alcohol, marijuana, and crack cocaine. In the present study, we chose to forego an attempt to fit cigarette use into a problem-based grouping system, and instead grouped our participants by the quantity of cigarettes smoked each day.

In terms of the present study, what is important to recognize is that these variations among the recent use groupings to some degree limit the comparisons that can be made across substances. Equally importantly, the grouping strategy for each particular drug defines the nature of the comparisons that can be made across the levels of use of each drug.

The next step in our analysis was to test whether the prison drug treatment program's diagnostic eligibility interview, which was used to create the groups described above, would yield clinically distinct subgroups of alcohol, marijuana, and crack cocaine users, despite the potential for symptom exaggeration that exists due to secondary gain associated with completion of the drug treatment program. We assessed the validity of the recent drug use categories derived from the diagnostic interview by comparing mean scores across subgroups on several self-report measures known to be related to substance abuse. We found that the subgroups for recent marijuana use and recent crack cocaine use appeared to be distinct from one another, and that problem users evinced higher levels of drug craving, problem recognition, drug use ambivalence, and drug treatment seeking than non-problem users. However, the marijuana and crack groups differed with respect to craving and motives for use, in that problem crack cocaine users appeared to be focused primarily on negative aspects of crack cocaine use.

When we compared the recent non-problem and problem alcohol use groups on these indices, we found that the problem users exhibited significantly higher levels of alcohol craving, drinking problem recognition, alcohol use ambivalence, and alcohol treatment seeking than non-problem users. Recent problem users also reported higher

lifetime alcohol use problems than non-problem users, as evidenced by significantly higher mean scores on the CAGE and the SMAST. However, *both* groups' mean scores on these instruments were indicative of a history of problematic alcohol use. This finding is not particularly surprising, given that this is a sample of women in treatment for substance use disorders. In clinical samples of substance use abusers, the prevalence of lifetime alcohol abuse is quite high. For many substance abusers, alcohol is often abused early on, and then replaced with another drug later; alternatively, abuse of alcohol may continue in conjunction with abuse of other drugs, but the users' recognition of alcohol abuse is obscured by the severity of the consequences associated with the "harder" drug. Unfortunately, the clinical interview that we used to form our groups did not ask about the presence of alcohol use problems prior to the target period (which was the 12 months prior to the arrest that led to participants' current incarceration). For these reasons, we suspect that in the present study our "non-problem" and "problem" alcohol use subgroups probably overlap to a certain extent.

A comparison of smoking-related constructs across the levels of our cigarette grouping variable yielded significant differences between current non-smokers and the three levels of smokers, in the expected directions. Based on these findings, we conclude that the marijuana, crack, and cigarette groupings are valid, and generally represent clinically distinct subgroups, whereas the two alcohol subgroups are probably less distinct from one another.

Reliability and Validation of Drug and Comparison Cue Sets

Our second hypothesis concerned content validity and reliability for our four drug cue sets and four comparison cue sets. The content validity for each individual cue was assessed by determining the number of participants who correctly identified the category that the cue represented. This was a feature that was added to the methodology for the present study because with the addition of two new drug cue sets for which visual cues are ambiguous, we suspected that some drug cues might be difficult to identify. Using a cutoff of 85% correct identification, we dropped two crack cocaine cues, one marijuana cue, and one cigarette cue from the sets. Based on the responses of participants who misidentified it, it appears that one of the two crack cocaine cues, which was a close up image of a crack "rock", was hard to recognize for two reasons: either it was mistaken for methamphetamine (likely by methamphetamine users), or it was simply unrecognizable (probably by participants who were unfamiliar with crack cocaine; more than one of these respondents identified the image as "bread crumbs", "muffins", or some other bread-like substance). The other crack cue, and also the marijuana and cigarette cues that were dropped, appear to have been incorrectly identified primarily because the images did not provide enough information to determine what substance was being smoked.

The reliability of the drug cue sets and the comparison cue sets was assessed by treating each cue set as a scale, and using Cronbach's alpha to calculate the overall scale reliability for each of the three ratings, arousal, approach, and avoidance. As

Table 4 indicates, the reliability of the four drug cue sets after the above-described deletions was quite high. The reliability of the comparison sets was somewhat lower; reflecting the relative heterogeneity of these cue sets vs. the drug cue sets.

Once we explored the validity of our recent drug use history grouping, and the reliability and content validity of the drug and comparison cue sets, we sought to demonstrate the specificity of our four drug cue sets. To accomplish this we conducted a series of four arousal control analyses, in which we grouped participants according to their recent use of each of the four drugs, and compared their arousal reactivity to the drug cue set to their reactivity to the four comparison cue sets. For cigarettes, marijuana, and crack cocaine, these analyses effectively demonstrated that variations in reactivity to the drug cues were attributable to differences among participants' recent use of the drugs, rather than to differences in general arousability. In a more stringent cross-over arousal control analysis, we conducted a series of three analyses that showed that even when other drug cue sets were used as comparisons, participants grouped by recent use of cigarettes, marijuana, and cocaine showed differential arousal only to the matched drug. Based on the results of these analyses, we concluded that participants' reactivity to our cigarette, marijuana, and crack cocaine cue sets was attributable to differences in their recent use of each specific drug, rather than to differences in reactivity to drug cues in general.

However, when participants were grouped according to recent alcohol use, the non-problem and problem alcohol users did not differ significantly in their arousal reactivity to the alcohol cue set. We regard this as further evidence that participants in these two groups share clinical similarities in their alcohol use histories.

Approach and Avoidance as Separate Reactivity Dimensions

As described in the introduction, recent developments in cue reactivity theory and research suggest that substance cue reactivity might be best conceptualized as a multidimensional constellation of responses to drug-relevant stimuli. We have proposed that a potentially useful means of operationalizing substance cue reactivity can be achieved by considering that a person's reactivity to a drug cue is directly related to his or her history of experiencing the rewarding and punishing consequences of using the drug. Repeated exposure to these consequences can result in the development of two distinct reactivity dimensions: appetitive motivation to approach and consume the drug, and defensive motivation to withdraw and avoid consuming the drug. Thus, we proposed that measuring these two response dimensions separately would yield a more clinically meaningful representation of reactivity.

In the present study, we evaluated our assertion that measuring avoidance reactivity as a separate response dimension would yield additional important information beyond that obtained by measuring approach reactivity alone in several ways. First, by examining the resultant scatterplots when approach and avoidance were placed as orthogonal axes, we demonstrated that at least some participants fell into each of the four quadrants of reactivity space for each of the four drugs. This pattern of dispersion is exactly what one would expect to find when evaluating the approach and avoidance

reactivity of a sample of diagnosed substance users. Of particular interest here is the scatterplot for the alcohol cues, which indicates that our sample does, in fact, show significant variation in terms of reactivity to alcohol cues. The fact that this variation was not detected by the arousal control analysis provides further evidence to suggest that our initial alcohol grouping strategy did not adequately differentiate types of alcohol users.

From a methodological standpoint, examination of the scatterplots for our four comparison cue sets appears to indicate that separating the food cue set and the non-alcoholic beverage cue set into two sets each resulted in improved differentiation between the sets of cues, which in turn allows for more finely grained comparisons between drug cues and comparison cues. The Unhealthy Food cue set provides a comparison cue set characterized by approach / ambivalence, whereas the Healthy Food and Non-Alcoholic Non-Caffeinated Beverage cue sets provide an indifferent / approach comparison cue set. The Non-Alcoholic Caffeinated Beverage cue set provides an avoidant / indifferent / approach cue set. Having comparison cue sets that are defined by the intensity and direction of approach and avoidance reactivity is helpful for interpreting responses to drug cues, because it places drug reactivity against a known and easily understood background. Thus, it becomes possible to characterize the strength and direction of respondents' reactivity to drug cues in contrast to their own reactivity to non-drug cues with similar motivational properties.

The main objective of the next set of analyses was to characterize the approach and avoidance reactivity patterns for the different recent use groups for each of the four drugs. The comparison cue sets were used to provide a background for interpretation of reactivity to the drug cues in terms of intensity. These analyses were designed to accomplish two goals: 1) to demonstrate that approach reactivity and avoidance reactivity vary as a function of recent use history for each drug, and, 2) to demonstrate that approach and avoidance represent distinct reactivity dimensions, each of which contributes important information in characterizing participants' drug cue reactivity. As was the case in the arousal control analysis, demonstrating this predicted between-groups variation would provide validation for the methodology. Accomplishing the second goal would provide validation for our conceptualization of cue reactivity. These analyses also serve the larger aim of characterizing the cue reactivity of our particular sample of substance abusers.

To facilitate discussion of these results, we will address each drug cue set separately, incorporating the findings regarding both the approach and avoidance dimensions. The results of these analyses for the cigarette cue set clearly indicate that both approach and avoidance vary as a function of recent use of cigarettes. Approach and avoidance to the four comparison cues and other drug cues do *not* vary as a function of recent cigarette use. Taken together, these results confirm the results of the arousal control analysis for the cigarette cues; that is, that our cigarette cues are specific to cigarettes. Non-Smokers' approach reactivity towards cigarette cues is virtually nonexistent. There was a significant increase in approach between Non-Smokers and Smokers who reported smoking 5 or fewer cigarettes per day, and approach to cigarettes continued to increase across the remaining two levels of smokers. In terms of intensity, the heaviest smokers (20 or more per day) showed approach to cigarettes that was *higher* than their approach to all of the comparison cues

except for Unhealthy Food. This indicated that for these smokers, cigarettes elicit the same amount of appetitive motivation as such items as ice cream sundaes and cheeseburgers, which are especially coveted commodities in a prison setting.

Avoidance to cigarettes showed a decreasing pattern across the smoking groups, with non-smokers showing a much higher level of avoidance to cigarettes than to all of the comparison cues. In contrast, there was no difference in the heaviest smokers' avoidance to cigarette cues and the comparison cues.

Recall that our cigarette grouping strategy is based only on quantity of use, rather than problems associated with smoking. The approach – avoidance pattern that we observed based on this grouping appears somewhat reciprocal, as would be expected for a grouping based on solely on quantity of use. Simultaneous examination the smoking groups' approach and avoidance reactivity (see Figure 10, panel 1) seems to suggest that if our sample contains ambivalent smokers they would most likely be found among smokers who smoke five or fewer cigarettes per day, or 10 cigarettes per day. Because approach increases as avoidance decreases, the results of this analysis are not sufficient to conclude that our second goal was met; that is, they could not establish that approach and avoidance reactivity each contributes unique information in characterizing participants' drug cue reactivity.

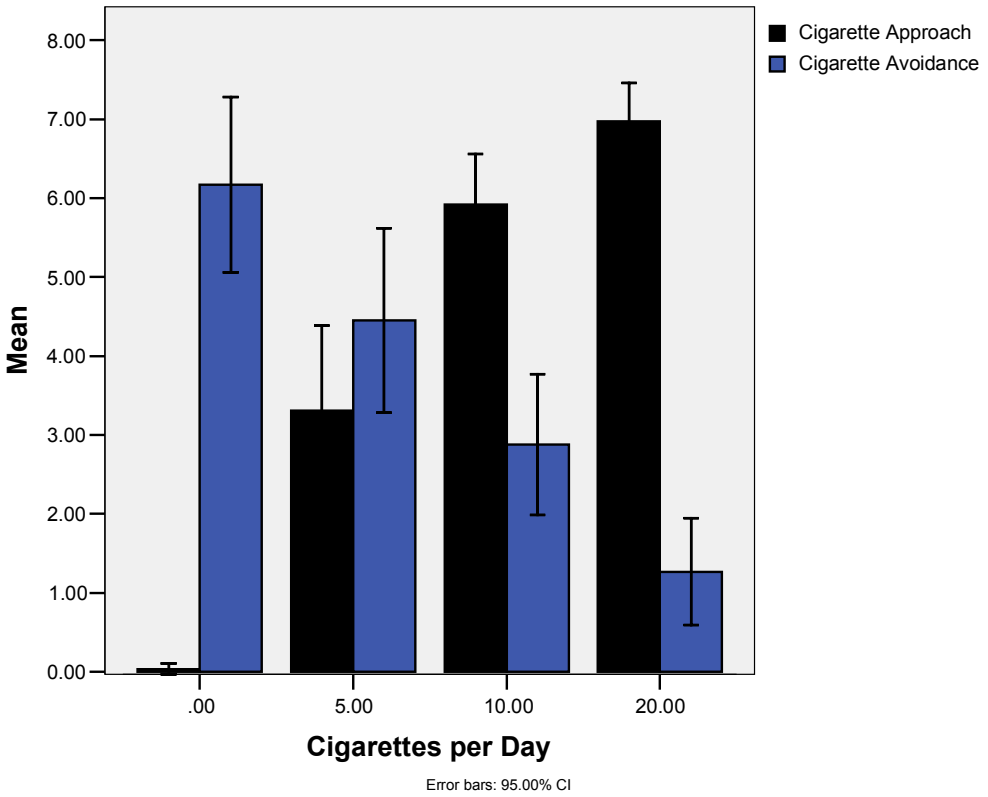

Figure 10: Approach and Avoidance by Recent Drug Use

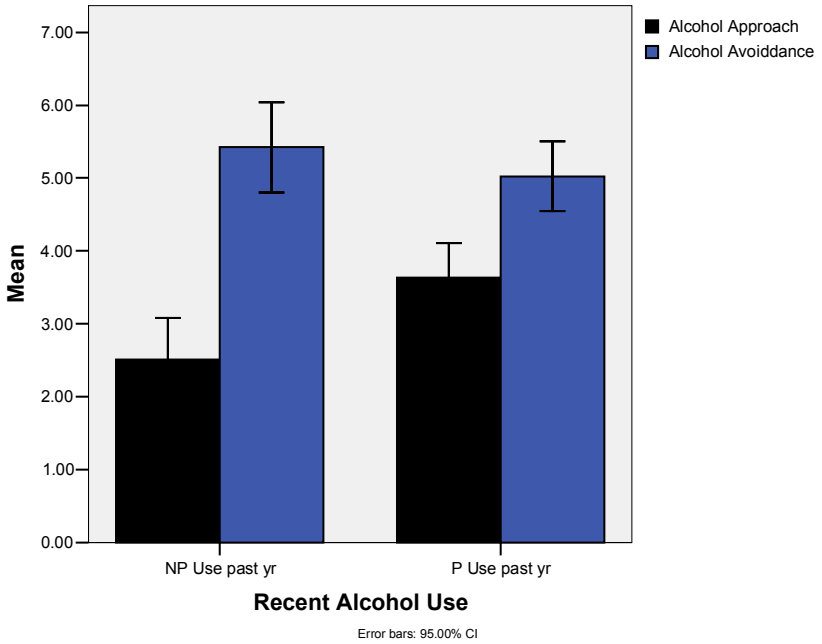

Figure 10: Continued.

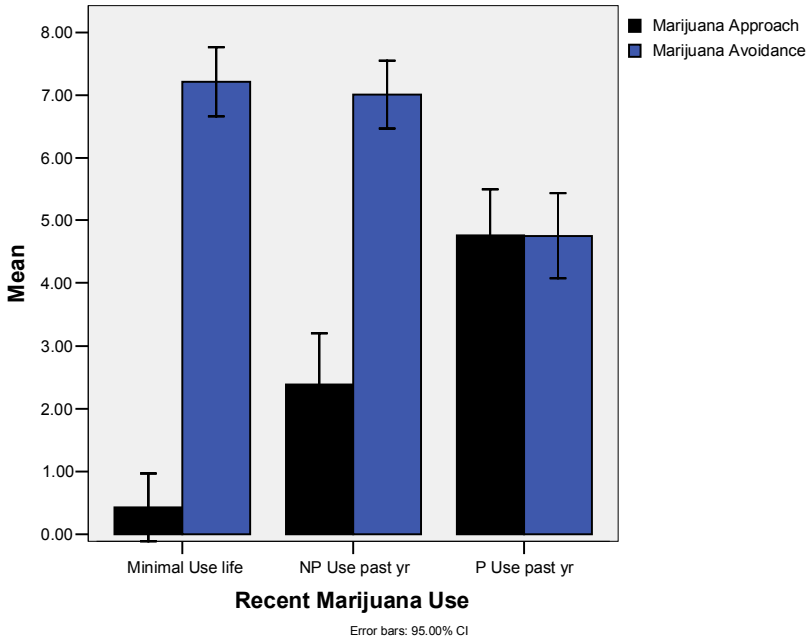

Figure 10: Continued.

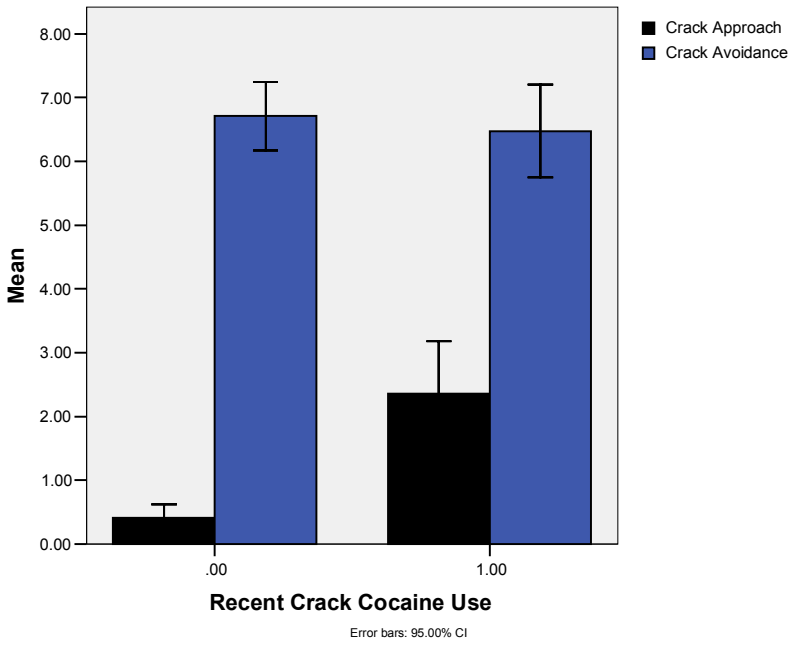

Figure 10: Continued.

The results of these analyses for marijuana also clearly indicated that both approach and avoidance varied as a function of recent marijuana use. Approach and avoidance to the four comparison cues and other drug cues, however, did *not* vary as a function of recent marijuana use. Thus, we can be confident that our first goal was accomplished; that is, that our marijuana cue set is specific to marijuana. The pattern of approach reactivity to marijuana cues across the marijuana use groups was similar to that observed for cigarettes. Non-users showed very little approach, non-problem users showed a significantly higher level of approach than non-users, and problem users showed a significantly higher level of approach than non-problem users. Non-problem users' approach to the marijuana cues was significantly lower than their approach to all four sets of comparison cues. In contrast, problem users' approach to marijuana was not significantly different than their approach to the healthy food comparison cues and the two non-alcoholic beverage cue sets; though it was significantly lower than their approach to the unhealthy food cues.

Avoidance reactivity to marijuana cues across the recent marijuana use groups showed a pattern different from that observed across the smoking groups for cigarette cues. For marijuana cues, non-users and non-problem users showed similarly high levels of avoidance, which was considerably higher than their avoidance reactivity to all four sets of comparison cues. Problem users' avoidance to marijuana cues was significantly lower than that exhibited by the non-users and non-problem users, though still significantly higher than their avoidance to all four kinds of comparison cues.

At first glance, the high level of avoidance exhibited by the non-problem use group appears to run counter to our assertion that among drug users, avoidance develops as a result of repeated exposure to negative consequences of marijuana use. If this were the case, then non-problem users might be expected to show *less* avoidance than problem users. However, an in-depth analysis of the overall pattern of marijuana approach and avoidance (see Figure 10, panel 2) suggests that the prison setting may exert an unusual influence on the non-problem users' avoidance reactivity. When presented with marijuana cues in the drug punishment cue-laden environment of the prison, non-problem users (who by definition like the drug but are not compelled to use it) show a modest level of approach to marijuana cues coupled with a high level of avoidance. This pattern suggests that non-problem users' reactivity to marijuana is being influenced simultaneously by their appetite for marijuana and their desire to avoid marijuana-related punishment. The proximity and strength of contextual punishment cues appears to be boosting avoidance reactivity. Analysis of problem marijuana users' approach and avoidance reactivity supports this interpretation. These users, who are compelled to use marijuana despite the accumulation of negative consequences of use, show a higher level of approach than non-problem users coupled with a level of avoidance that is lower than that evinced by non-problem users. For these users, approach and avoidance inclinations are relatively high *and* similar in intensity, reflective of their ambivalence toward marijuana.

In summary, the approach and avoidance reactivity pattern observed for marijuana cues across our sample can be construed as supportive of both of the goals of this analysis. Approach and avoidance reactivity are both shown to vary as a function of recent marijuana use, and further, approach and avoidance reactivity to marijuana cues each appears to contribute unique information that can be combined to characterize distinct reactivity patterns among the different recent use groups.

Analysis of approach reactivity to crack cocaine cues shows a somewhat different pattern than that observed for marijuana and cigarettes. Like non-users of cigarettes and non-users of marijuana, non-users of crack showed an extremely low level of approach to crack cocaine cues. Likewise, problem users showed a significantly higher level of approach to crack cocaine cues. However, in contrast to the approach to marijuana cues exhibited by problem marijuana users, the intensity of problem users' approach to crack cocaine cues remained significantly lower than their approach to all four of the comparison cue sets.

Avoidance reactivity to crack cocaine cues was not significantly different between the two crack cocaine use groups; non-users and problem users both showed avoidance to crack that was significantly higher than their avoidance to all of the comparison cues. When approach and avoidance reactivity to crack cocaine cues are considered simultaneously (see Figure 10, panel 3), it is apparent that problem crack users as a group do not show a pattern indicative of ambivalence toward crack cocaine cues; rather, they appear to show a reactivity pattern characterized by strong avoidance. What cannot be determined from this analysis is whether this reactivity pattern is uniform across all problem users, or if subgroups with different patterns exist. Because we have reason to believe that the non-use and problem use crack cocaine subgroups are validly differentiated from one another, the lack of difference in avoidance reactivity to crack cocaine cues (see Figure 10, panel 4), can be attributed to

one of several causes: first, it could have occurred because avoidance is not a valid reactivity dimension with respect to crack cocaine; second, it may reflect a unique characteristic of crack cocaine, the prison environment, or an interaction between these factors.

To summarize, we found that approach but not avoidance varied across recent crack use groups. Overall, approach to crack cocaine cues was relatively low, and avoidance to crack cocaine cues was relatively high. Because avoidance does not vary between the two groups, these results provide no evidence to support the assertion that measurement of avoidance reactivity provides additional information toward understanding crack cocaine cue reactivity beyond that provided by the measurement of approach inclination – at least not in a prison population.

Analysis of approach reactivity to alcohol cues showed a pattern of results that was roughly equivalent to the pattern of approach to marijuana cues observed between non-problem and problem marijuana users. That is, non-problem users' approach to alcohol cues was significantly lower than their response to all four of the comparison cue sets, and problem users' approach to alcohol cues was significantly higher than non-problem users' approach to alcohol cues. Problem users' approach to alcohol cues was similar to their approach to Non-Alcoholic Caffeinated Beverage cues and Healthy Food cues, though still lower than their approach to Unhealthy Food cues and Non-Alcoholic Non-Caffeinated Beverage cues. (Note that the lack of a non-user alcohol group limits our ability to comment on the intensity of approach evinced by the non-problem users. However, it is helpful in this regard to report that the intensity of non-problem alcohol user's mean approach to alcohol cues was similar to non-problem marijuana users' approach to marijuana cues.)

Analysis of avoidance reactivity to alcohol cues did not differ significantly between the recent alcohol use groups. Both the non-problem alcohol use group and the problem alcohol use group showed a relatively high level of avoidance; that is, significantly higher than the avoidance they displayed toward the four sets of comparison cues. In this case, we suspect that overlap in terms of alcohol use history between the two groups may account for the lack of significant difference in avoidance between these two groups.

Collectively, the results of these analyses across the four drug cue categories provide considerable reason for optimism with respect to the validity of our methodology and conceptualization of cue reactivity. Approach reactivity proved to vary as a function of recent use for each of the four drug cue sets; furthermore, in accord with the prediction of our model of cue reactivity, approach intensity increased as level of involvement with each drug intensified. We were also able to use the comparison cues to characterize users' approach reactivity to the four drugs at each level of use, within a fixed framework that allowed for meaningful comparisons within and across the drug categories.

For the cigarette and marijuana cue sets, analysis of avoidance reactivity also provided support for the validity of our methodology and the predictions of our cue reactivity model. A particularly important finding here was the illustration of the fact that different reactivity patterns emerge depending on the basis of the recent use grouping variable. Our quantity-based cigarette use groups evinced an approach – avoidance reactivity pattern that suggests that the most likely place to find ambivalent smokers

would be in the two middle groups: smokers who smoke 5 or fewer cigarettes per day, and smokers who smoke approximately 10 cigarettes per day. In contrast, our problem-based marijuana grouping variable resulted in an approach – avoidance pattern that suggests that ambivalent marijuana users are most likely to be found in the problem use group. Due to a lack of variation in avoidance reactivity between the levels of the alcohol and crack cocaine groups, little was learned from these analyses about the potential for avoidance to contribute unique information in characterizing substance abusers' cue reactivity.

The next set of approach and avoidance analyses was designed to elaborate on the preceding analyses, by attempting to determine whether the participants who fell into each of the four quadrants of approach and avoidance-derived 'reactivity space' actually appear to have arrived there because they possess the characteristics that we presume should be exhibited by the inhabitants of each of those spaces. In other words, these analyses were designed to determine whether participants' dispersion across the quadrants of reactivity space was systematically related to recent drug use history. As we pointed out, if the reactivity space quadrants are valid, then there should be clinically meaningful differences between the respondents in each quadrant for any given drug, and, there should be clinically meaningful similarities between the members of corresponding quadrants across the four drugs. This issue was investigated for each drug primarily by simply examining the cross tabulation between the recent use grouping variable and the reactivity space quadrants variable.

Several important patterns emerged as a result of examination of the cross tabulations. First, the majority of the non-users of each drug were found in the Avoidant quadrants, with virtually all the remaining non-users found in the Indifferent quadrants. In a way, this finding serves as validity check for the reactivity space quadrants, because there is no credible reason for non-users to be found in either the Approach or Ambivalent quadrants. The majority of the non-problem users of alcohol, marijuana, and crack cocaine were found within the Avoidant quadrants for each drug. Although this finding might be puzzling or troubling if observed in a community or college student sample, it is not particularly surprising in this sample of incarcerated substance abusers. In effect, either because of the impact of the treatment setting or the prison setting (or a combination of both elements), these non-problem users are essentially reporting that they currently feel inclined to stay away from those drugs that they do not feel compelled to use. It would, however, be a challenge to the validity of the reactivity space quadrants if *problem users* were similarly concentrated in the Avoidant quadrant. Examination of our sample reveals that for marijuana and alcohol, the problem users are reasonably well spread out over the Approach, Avoidant, and Ambivalent quadrants. This is consistent with the idea that a cross-section of substance abusers in treatment is likely to reflect heterogeneity in terms of their positions along the stages of change continuum. In contrast, a large proportion of our problem crack cocaine users did fall within the Avoidant quadrant, again underscoring the distinction between crack and the other two drugs.

In the previous section, our analyses of the approach and avoidance reactivity patterns for cigarettes and marijuana resulted in a basis for predicting which level of each these recent use grouping variables was most likely to contain ambivalent responders. For cigarette users, we predicted that ambivalent responders would most

likely be found in the 5 or fewer per day cigarette smokers, or the approximately 10 cigarettes per day smokers. In fact, 12 of the 15 smokers in the Ambivalent quadrant were members of these two groups. Similarly, from our marijuana approach – avoidance reactivity pattern, we predicted that the problem use group of marijuana smokers would be the most likely level of the recent marijuana use grouping variable to contain ambivalent responders to marijuana cues. In fact, 21 of the 31 ambivalent responders were found within the problem use group. These findings are valid from a clinical perspective, as well, because the most likely smokers to be ambivalent are those attempting to limit their daily consumption (i.e., to less than the common "pack a day"), and, among drug users the most likely to be ambivalent are the problem users.

Further support for the clinical validity of our reactivity space quadrants was found when we were able to demonstrate significant differences between the approach and ambivalent quadrants in terms of participants' SOCRATES scale scores. Respondents in the ambivalent quadrant for marijuana cues showed a higher level of Problem Recognition, whereas respondents in the ambivalent quadrant for cigarette cues showed a higher level of Ambivalence. These are two constructs that obviously relate directly to the key hypothesized difference between the Approach and Ambivalent groups, that is, that the ambivalent users have concerns about their use and are contemplating change. Altogether, the results of the analyses of reactivity space provide support for our conceptualization of cue reactivity, by clearly illustrating that measuring avoidance as a separate dimension from approach results in an improved ability to capture clinically meaningful differences among substance users.

For exploratory purposes, we also tested whether approach and avoidance incrementally predicted scores on the substance use-related individual difference measures that we administered to participants in our sample. Some potentially interesting findings emerged in these analyses, and these will be examined more closely in future studies.

We had hoped to use the results of our cigarette availability manipulation to assist in interpreting the results of this study. Unfortunately, this manipulation was apparently too weak to impact smokers' reactivity to the cigarette cues. There are probably three factors that contributed to the failure of this manipulation. First, the manipulation we used was an adaptation of a design that was initially intended for use with smokers who are generally free to smoke whenever they choose. Our sample was different, in that they were already subject to externally imposed regulation of their smoking times. In addition, they were already accustomed to periodic, random curtailing of their scheduled smoking breaks (i.e., whenever the compound was "locked down" due to weather, random counts, etc.). Finally, by virtue of the design, half the groups were able to "prepare" for the session in which they would have to forego their smoke break – and a number of participants reported smoking more than they normally did in the hours preceding that session. Whatever the cause, the manipulation clearly failed, thus providing no assistance in further evaluation of our model or interpretation of our findings.

Summary and Future Directions

The significance of the present study can be represented in terms of what it contributes to three areas within the study of cue reactivity: population, methodology, and theory. This study was the first cue reactivity study to be conducted within a prison substance abuse treatment setting. Thus, our sample of women prisoners with substance use disorders is unique. We evaluated the substance use characteristics of our participants, and found that they exhibited a wide range of recent substance use disorders, including problematic use of the four drugs specifically examined in the present study. We found that the sample displayed a range of severity of use in terms of marijuana, but was somewhat homogeneous with respect to history of alcohol use problems. We found a substantial portion of women who had abused crack cocaine, but few women who reported recent non-problem use of crack. A large proportion of our participants reported current use of cigarettes, and there was substantial variation within smokers in terms of daily quantity of cigarettes consumed. We also determined that despite the potential for symptom exaggeration due to secondary gain associated with participation in the prison's drug treatment program, the diagnoses obtained via the program's entrance interview proved to be valid. Overall, the results of our examination of this sample suggest that this population is one that can and should be included in future studies of substance cue reactivity, because they have a high prevalence of severe substance abuse, and because study of this population represents an opportunity to explore the unique impact that a restricted environment appears to have on substance cue reactivity.

In terms of methodology, the first contribution of the present study is related to setting. This study is the first to assess the viability of conducting a cue reactivity study within the context of a prison drug treatment program. We demonstrated that meaningful reactivity to alcohol, marijuana, and cigarette cues can be elicited and measured within this setting. The results regarding crack cocaine proved questionable, in terms of utility. Based on information obtained from the cocaine-related individual difference measures, it appears likely that these problem crack users have accumulated a considerably high degree of negative consequences as a result of their crack cocaine use. As a result, their current expectations about crack use are overwhelmingly negative. It may be the case that the prison environment simultaneously insulates them from the painful circumstances that precipitated their crack use, and also enhances the salience of the negative consequences of crack use (and the positive consequences of refraining from use). Additional study of reactivity to crack cocaine, perhaps with a larger sample of users who, as a whole, exhibit more variability in recent use history may serve to shed light on this issue.

Although we intended to attempt to assess the impact of participants' perceptions of drug availability on reactivity, we were unable to do so, in part because of restrictions imposed by the prison authority in terms of asking about the presence of drugs in the prison, and in part because of the difficulty of manipulating availability of the one permitted drug (cigarettes) in an already highly controlled setting. Because perceptions of availability are known to impact drug cue reactivity, the inability to measure such perceptions constitutes a limitation in the present study. The findings of the present

study suggest that some dimensions of reactivity appear to be affected by aspects of the prison context, but it is not possible to determine if this impact was caused by perceptions of drug availability, or by the enhanced presence of drug punishment cues inherent within the prison context, or by a combination of both of these factors. Future studies undertaken in this context should attempt to develop means of assessing these factors.

Also in terms of methodology, the present study sought to build upon recent advancements in the study of substance cue reactivity that have set improved criteria for establishing the reliability and specificity of drug cues. Using an arousal control analysis as proposed by Robbins and Erhman (1992), we established the specificity of our visual cue sets for cigarettes, marijuana, and crack cocaine. With this study, we also improved the comparison capability of our food and non-alcoholic beverage cue sets by grouping each set into two subcategories and demonstrating that each grouping elicited a unique reactivity pattern.

Finally, drawing on the recent empirical and theoretical work of a number of substance reactivity researchers, we attempted to develop a cue reactivity methodology capable of eliciting and measuring what we consider to be two of the most critical dimensions of reactions to substance cues, approach and avoidance motivation (Larsen et. al., 2001; Sayette et. al, 2000; Stewart, 1999). The present study was designed to simultaneously and orthogonally assess the approach and avoidance reactivity elicited from a clinical sample of substance abusers by our sets of visual cigarette, alcohol, marijuana, and crack cocaine cues. Overall, findings from this study provide considerable support for the incremental utility of separately measuring these two reactivity dimensions. We found significant differences in approach and avoidance reactivity to cigarette cues between smokers grouped by the amount of cigarettes consumed per day. Similarly, we found that approach and avoidance reactivity to marijuana cues differed significantly between recent non-problem and problem marijuana users. Importantly, a distinct pattern of avoidance reactivity emerged for each of these two drugs, and the patterns appear to be related to the different ways that the groups were formed. When only current quantity of use was considered (i.e., number of cigarettes per day), the avoidance exhibited by the group with the highest level of use was much lower than their approach. Alternatively, when the groups were formed based on diagnosis, the problem use group showed equal levels of moderate approach and avoidance.

Particularly intriguing among the findings related to approach and avoidance was the detection of clinically meaningful differences between the groups of participants across the quadrants of 'reactivity space' for each drug, and, the similarities between inhabitants of corresponding quadrants across three of the drugs (alcohol, marijuana, and cigarettes). Based on these findings, it appears that future studies designed specifically to compare differences across respondents in the reactivity space quadrants could yield important information.

APPENDIX A

Eligibility Interview

BUREAU OF PRISONS

RESIDENTIAL TREATMENT ELIGIBILITY INTERVIEW

A. INTERVIEW INFORMATION

1. Interviewer's Name:	2. Date:
3. Institution:	

B. DEMOGRAPHICS

4. Inmate's Name:	Reg#:
5. Age:	6. Date of Arrest/Violation:
7. Length of Sentence: _____ # Mo.	
8. Marital Status:	9. Number of Children:
10. # Years of Education Completed:	
11. Primary Occupation:	
12. Notes:	

C. SUBSTANCE USE HISTORY

NOW I AM GOING TO ASK YOU SOME QUESTIONS ABOUT YOUR SUBSTANCE USE HISTORY. HOW OLD WERE YOU WHEN YOU FIRST USED....

SUBSTANCE	EVER USED YES/ NO	AGE OF FIRST USE	AGE(S) OF HEAVIEST USE	TOTAL DURA-TION OF USE	FREQUENCY OF USE IN LAST PERIOD OF 12 CONSECUTIVE MO. ON THE STREET. **(see coding below)
12. Alcohol	Y/N				
13. Marijuana, hashish	Y/N				
14. Hallucinogens, LSD	Y/N				
15. Inhalants, glue, solvent	Y/N				
16.Amphetamines, speed, ice, crank	Y/N				
17. Barbiturates, tranquilizers, sedatives	Y/N				
18. Cocaine, crack, freebasing	Y/N				
19. Opiates, heroin, codeine, etc.	Y/N				
20. Illegal Methadone	Y/N				
21. PCP	Y/N				
22. Other-Specify	Y/N				

** Coding of frequency of use during last period of 12 consecutive months on the street:

0= No use

1= Less than once a week

2= More than once a week but not daily use

3= Daily use

D. PREVIOUS TREATMENT HISTORY

23. Before now, how many times have you been in a drug abuse treatment program?_____

24. If applicable, what type of treatment were you in?
   a. Out-Patient (No Medications) #____
   b. Out-Patient Methadone Maintenance #____
   c. Out-Patient Methadone Detox #____
   d. In-Patient/Hospital 30 days or less #____
   e. In-Patient/Hospital 30 days or more #____
   f. Residential Program 3-6 months #____
   g. Residential Program 7-12 months #____
   h. Therapeutic Community 13 months+ #____

25. If applicable, did you successfully complete any of these treatment program(s)? Y/N

26. If YES, which one(s)?

27. Did you ever attend any self-help groups? _____YES _____NO
   If yes, what was the longest consecutive period you attended? _____

28. Have you ever been in any kind of mental health treatment, other than substance abuse? Y/N

29. If YES, what did this treatment entail?

E. DIAGNOSTIC WORK ET

IN THE TOP BOXES PRINT NAMES OF DRUGS USED IN THE LAST PERIOD OF 12 CONSECUTIVE MONTHS ON THE STREET. IN TABLE, CIRCLE SYMPTOM# IF PRESENT.				
30. Over a period of time did you increase the amount of ____ which you used in order to become intoxicated or get the effect you wanted?	1	1	1	1
31. Over a period of time did the effect of ____ lessen as you used the same amount?	1	1	1	1
32. When you didn't use ____ for awhile or used less of it than usual, did you experience withdrawal symptoms?	2	2	2	2
33. Did you use ____ or a similar substance in order to get rid of withdrawal symptoms?	2	2	2	2
34. Did you often use a greater amount of ____ than you intended?	3	3	3	3
35. Did you often use __ for a longer period of time than you intended?	3	3	3	3
36. Did you persistently want to control or reduce your use of ____?	4	4	4	4
37. Were you persistently unsuccessful in your attempts to control or reduce your use of ____?	4	4	4	4
38. Did you spend a great deal of time obtaining, using, or recuperating from _____?	5	5	5	5
39. Did you give up or reduce important social, occupational, or recreational activities because of your use of _____?	6	6	6	6
40. Did you continue to use _____ even though you knew that it caused or worsened a physical or psychological problem?	7	7	7	7
41. Did your use of _____ sometimes lead to failure to fulfill your major obligations at work, school, or home?	8	8	8	8
42. Did you sometimes use _____ in situations in which it was physically hazardous?	8	8	8	8
43. Did your use of _____ sometimes lead to legal problems?	8	8	8	8
44.. Did you continue to use _____ even though it caused or worsened problems with other people?	8	8	8	8
45. Have 3+ different symptoms #1-7 been endorsed for _____?	YES NO	YES NO	YES NO	YES NO
46. Has symptom #8 been endorsed for _____ at least once?	YES NO	YES NO	YES NO	YES NO
47. What is the appropriate diagnosis for _____?	DEPN ABSE None	DEPN ABSE None	DEPN ABSE None	DEPN ABSE None

DSM-IV DIAGNOSTIC IMPRESSION

48. Check all which apply:

_____ 303.90 Alcohol Dependence	_____ 305.00 Alcohol Abuse
_____ 304.30 Cannabis Dependence	_____ 305.20 Cannabis Abuse
_____ 304.20 Cocaine Dependence	_____ 305.60 Cocaine Abuse
_____ 304.90 Phencyclidine (PCP) Dependence	_____ 305.90 Phencyclidine (PCP) Abuse
_____ 304.00 Opiod Dependence	_____ 305.50 Opiod Abuse
_____ 304.50 Hallucinogen Dependence	_____ 305.30 Hallucinogen Abuse
_____ 304.60 Inhalant Dependence	_____ 305.90 Inhalant Abuse
_____ 304.10 Sedative Dependence	_____ 305.40 Sedative Abuse
_____ 304.40 Amphetamine Dependence	_____ 305.70 Amphetamine Abuse
_____ 304.80 Polysubstance Dependence	_____ 305.90 Other Substance Abuse
_____ 304.90 Other Substance Dependence	_____ V71.09 No Diagnosis

Circle YES or NO for each:

49. The diagnostic impression is substance abuse or dependence:	YES NO
50. The central file supports this diagnostic impression:	YES NO
51. The inmate has signed an agreement to participate:	YES NO
52. Thus, the inmate is eligible for residential treatment:	YES NO
53. The inmate's case manager has indicated the absence of a violent current offense:	YES NO
54. There is an absence of a violent conviction history:	YES NO
55. Thus, the inmate is eligible for time off his/her sentence:	YES NO

56. Comments:

_____

_____

_____

Interviewer:_____ Date:_____

Coordinator:_____ Date:_____

INMATE'S PROBLEM STATEMENT

I have been interviewed to determine my eligibility for admission to a residential drug abuse treatment program in the Federal Bureau of Prisons. During the interview I have given truthful answers to all questions. I had an alcohol or drug use problem during the last period of 12 consecutive months in which I was in the community, and I am now seeking treatment for that problem.

Inmate: _____ Date: _____

APPENDIX B

Instructions to Participants

Part One: Substance Cue Rating Task

Thank you for volunteering to participate in this research project this afternoon. As you were told when you signed up for the study, your participation will consist of completing two tasks on three separate days: first a picture viewing exercise, and then completion of some questionnaires about yourself.

For about the next 50 minutes, you will be looking at pictures of things that people consume. You will be viewing each item, and then recording your own personal reactions to each one in the booklet in front of you. Before we begin, I will explain how to use the rating scales in the booklets to record your reactions, and show you some sample items so that you can practice using the rating scales.

Please open your booklet to page number one. Here, you will see the three scales that you will be using to rate each picture. The first scale on this page is called the Approach Scale. It asks you, "How much do you want to consume the item right now?" With this scale, you tell how strongly you wanted to consume the item in the picture, *as you were looking at the picture on the screen*. It is important that you realize that this scale is NOT asking you to say what you would actually DO, but rather how you FELT in terms of wanting to consume the item.

The second scale on page one is the Avoidance Scale. It asks you, "How much do you want to avoid consuming the item right now?" With this scale, you tell how strongly you felt you wanted to keep from consuming the item in the picture, *as you were looking at the picture on the screen*. Again, it is important that you realize that this scale is asking you to report how you FELT rather than what you would actually DO.

Before we talk about the third scale, let me give you some examples that show how these first two scales work. Imagine that the first picture that you see shows a big ice cream cone. Suppose that you have just come here from your work detail, and you

haven't had dinner yet so you're really hungry, and it just so happens that ice cream is your favorite food. If that were the case, you would probably make a pretty high rating on the Approach Scale, and a pretty low rating on the Avoidance Scale.

Now, let's imagine the same situation, with one more thing added: Suppose you're hungry because you haven't had dinner, and you love ice cream, BUT, you're on a diet because you want to lose some weight. If this were the case, you'd probably make a pretty high rating on the Approach Scale, AND also make a pretty high rating on the Avoidance Scale, because you'd have mixed or ambivalent feelings about wanting to eat the ice cream.

Ok, now, imagine that you've already had dinner, and you don't like ice cream much because it always gives you an upset stomach. In that case, when you see the picture of the big ice cream cone, you would probably give a pretty low rating on the Approach Scale, and a pretty high rating on the Avoidance Scale.

For this last example, imagine this: you've already had dinner, and you're one of those people who can take ice cream or leave it. In this case, when you see the ice cream cone, you might make a low rating on the Approach Scale, and also make a low rating on the Avoidance Scale because you are really indifferent.

Do you see how the two scales work, separate from one another? Does anyone have any questions about how to use these scales? (Answer any questions for clarification of the rating scales.)

The third scale on the page is the Excited / Aroused Scale. This scale asks you "How excited or aroused does seeing this item make you feel right now?" With this scale, you tell how you were feeling *as you were looking at the picture on the screen*. One end of this scale is marked "Completely Calm". This means you felt completely relaxed, calm, tranquil, peaceful. The opposite end of this scale is marked "Completely Aroused". This means you felt completely excited, hyper, jittery, aroused, charged up. The middle of the scale is marked "Neutral". This means that looking at the picture didn't make you feel either way, calm or excited. Choose the number that best describes how you were feeling as you were looking at each picture.

Are there any questions about the three rating scales? (Answer any questions for clarification of the rating scales.)

When we are ready to begin, you should all be paying close attention to the screen at the front of the room. Before each image that you will rate, a screen will appear to remind you of what page you should be on in your booklet. This reminder screen will stay for a few seconds, and then it will be replaced by the picture you are to rate on that page. Each picture that you are to rate will stay on the screen for **five** seconds. **It is very important that you keep looking at the picture for the entire time that it is on**

the screen. Look at the picture, and do not start making your ratings until the picture disappears and is replaced by the screen that says, “please make your ratings now”.

Please note that the three scales are mixed up on each page, so that on some pages the Approach Scale comes first, on some pages the Avoidance Scale comes first, and on some pages the Excited / Aroused Scale comes first. It’s very important that you read the scales on each page so that you can make your ratings correctly.

Finally, please do not talk to each other or make any comments at all during the whole time that we are looking at and rating the pictures. It’s very important to make sure that no one influences anyone else’s ratings. REMEMBER, there are NO right or wrong answers here. I am interested in your honest and accurate reactions, so please do the best you can to use the scales to tell how you felt as you were looking at each picture.

Part Two: Self-Report Questionnaires

During this part of the study, you will be filling out several questionnaires that ask you to describe yourself. If you open your folders, you will notice that there are several different packets of questionnaires inside. Please complete all the questionnaires in your folder, in the order that they have been arranged. If you have any questions about this procedure, or about any of the questionnaires, please raise your hand and I will come to speak with you individually.

Please read the instructions at the top of each questionnaire in each packet carefully. Some of the questionnaires will ask you to report about your feelings, thoughts and behavior **NOW**, while others will ask you to report about the way you were **during the last year that you spent outside of prison or jail.** Therefore, it’s very important that you make sure you respond to each questionnaire using the correct time frame.

When you are finished, please bring your whole packet up to me so that I can check it to make sure you’ve completed all your work. I will also need to have you sign out on the attendance sheet.

Once again, thank you for volunteering.

APPENDIX C

Arousal Control Analyses

Arousal Analyses Question 1: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to non-drug comparison cues?

Cigarettes

Mean arousal ratings for cigarettes and the four comparison cue sets, with the participants grouped by current smoking status, are presented in Figure 11, first panel. As predicted, the multivariate Cigarette Use X Cue Type interaction was significant, $F(4, 122) = 15.82$, $p < .001$, $eta^2 = .34$. A follow up between-subjects ANOVA with the five cue types as dependent variables revealed that arousal ratings to cigarettes increased between Non-Smokers and Smokers, $F(1, 125) =$, $p = .001$, $eta^2 = .36$, while there were no significant differences between smoking status groups in arousal ratings to the four sets of comparison cues: Unhealthy Food, $F(1, 125) = .92$, ns; Healthy Food, $F(1, 125) = .68$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 125) = 1.11$, ns; Non-Alcoholic Caffeinated Beverages, $F(1, 125) = 1.65$, ns.

Alcohol

Mean arousal ratings for Alcohol cues and the four comparison cue sets, with the participants grouped by recent alcohol use, are presented in Figure 11, second panel. As predicted, the multivariate Alcohol Use X Cue Type interaction was significant, $F(4, 142) = 2.85$, $p = .03$, $eta^2 = .07$. However, a follow up between-subjects ANOVA, with arousal for each of the five cue types as dependent variables, was not significant for any of the cue types, suggesting that arousal ratings did not differ significantly as a function of recent alcohol use: Alcohol, $F(1, 145) = 4.95$, ns; Unhealthy Food, $F(1, 145) = 1.43$, ns; Healthy Food, $F(1, 145) = .3$, ns; Non-Alcoholic, Non-Caffeinated Beverages, $F(1, 145) = .52$, ns; Non-Alcoholic, Caffeinated Beverages, $F(1, 145) = 1.46$, ns.

Marijuana

Mean arousal ratings for marijuana cues and the four comparison cue sets, with the participants grouped by recent marijuana use, are presented in Figure 11, third panel. As predicted, the multivariate Marijuana Use X Cue Type interaction was significant, $F(8, 288) = 5.03$, $p < .001$, $eta^2 = .12$. A follow up between-subjects ANOVA, with mean arousal for each cue type as the dependent variables, revealed a significant main effect for arousal to marijuana cues, $F(2, 147) = 25.15$, $p < .001$, $eta^2 = .26$; however, there were no significant group differences in arousal ratings for the four sets of comparison cues: Unhealthy Food, $F(2, 147) = 3.46$, ns.; Healthy Food, $F(2, 147) = 1.31$, ns.; Non-Alcoholic, Non-Caffeinated Beverages $F(2, 147) = 3.14$, ns.; Non-Alcoholic, Caffeinated Beverages $F(2, 147) = 2.31$, ns. Planned contrasts showed that mean arousal ratings to marijuana cues increased significantly between Minimal Users and Non-Problem Users, $t(147) = 3.56$, $p = .001$, and also between Non-Problem Users and Problem Users $t(147) = 3.27$, $p = .001$.

Crack Cocaine

Finally, mean arousal ratings for crack cocaine cues and the four comparison cue sets, with the participants grouped by recent crack cocaine use, are presented in Figure 11, fourth panel. As predicted, the multivariate Crack Cocaine Use X Cue Type interaction was significant, $F(4, 126) = 7.67$, $p < .001$, $eta^2 = .20$. A series of five follow up between-subjects ANOVAs, one for each cue type, revealed a significant main effect for arousal to crack cocaine cues, $F(1, 63.7) = 18.72$, $p < .001$; however, there were no significant group differences in arousal ratings for the four sets of comparison cues: Unhealthy Food, $F(1, 129) = .31$, ns.; Healthy Food, $F(1, 129) = 3.0$, ns.; Non-Alcoholic, Non-Caffeinated Beverages $F(1, 129) = 6.09$, ns.; Non-Alcoholic, Caffeinated Beverages $F(1, 129) = 3.32$, ns.

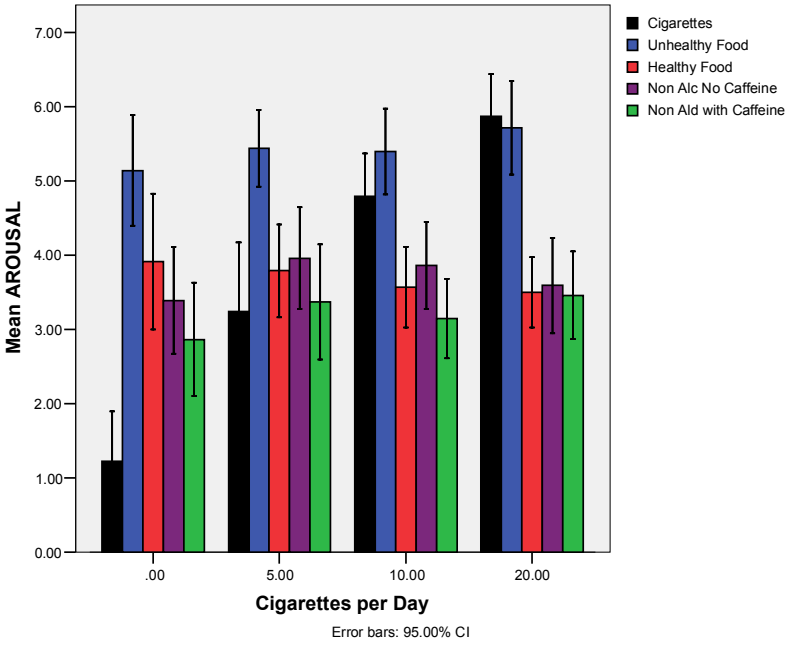

Figure 11 : Arousal – Drug vs. Comparison Cues

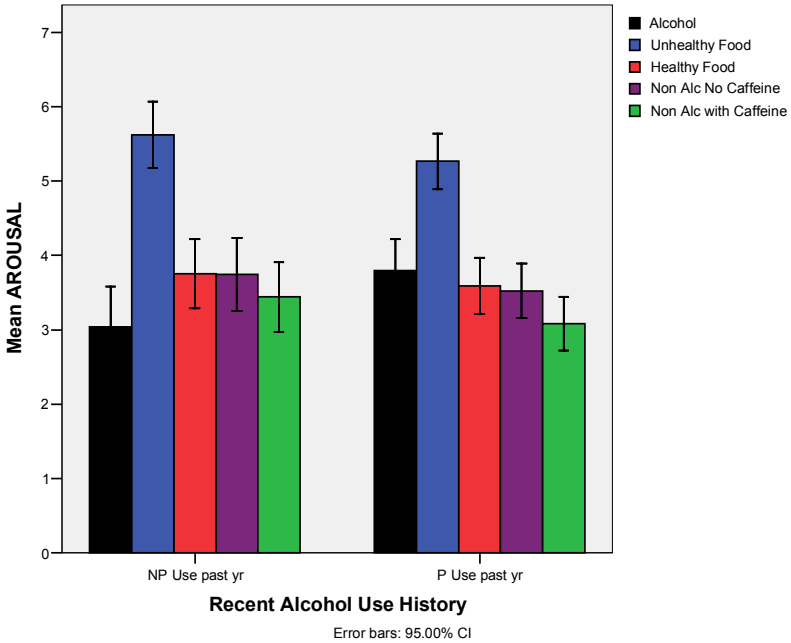

Figure 11 : Continued.

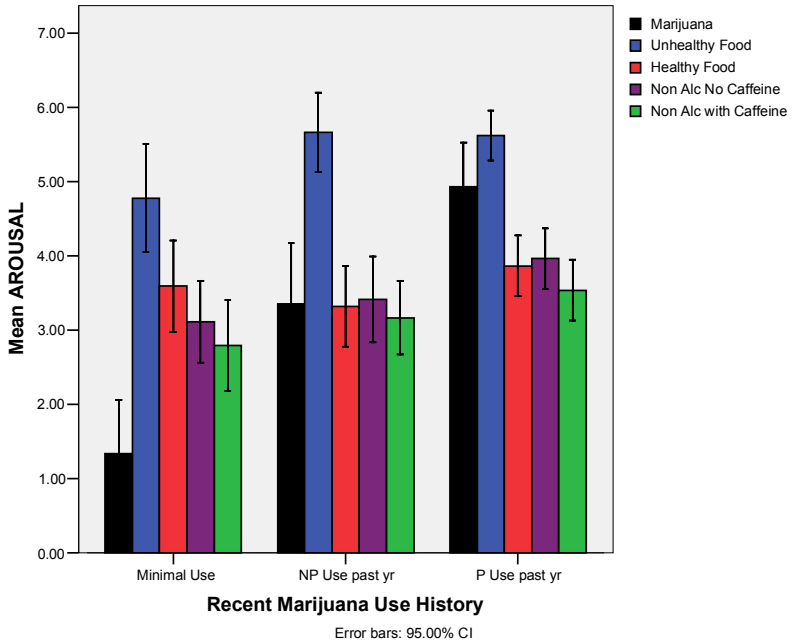

Figure 11 : Continued.

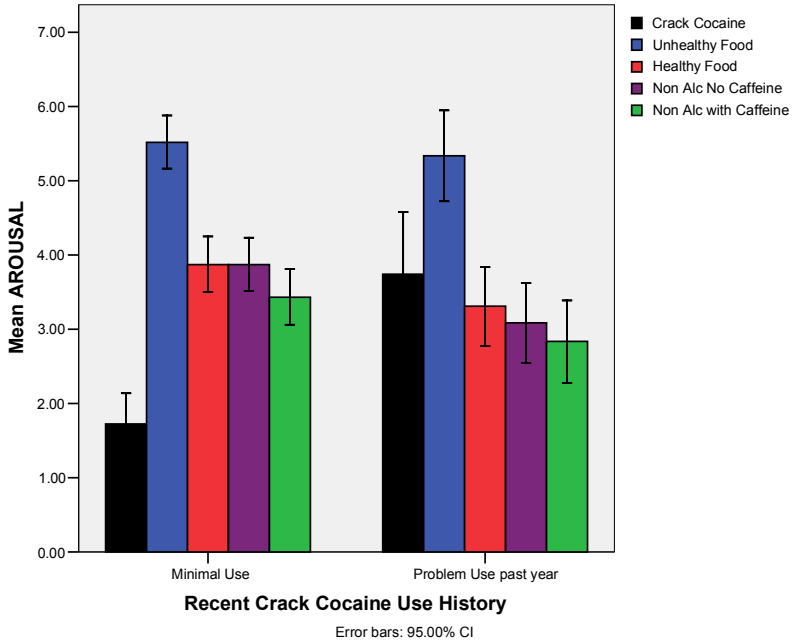

Figure 11 : Continued.

Arousal Analyses Question 2: When participants are grouped according to recent use of a specific drug, how does reactivity to cues for that drug relate to reactivity to non-drug comparison cues?

Cigarettes

For Non-Smokers, there was a significant main effect for cue type $F(3.36, 97.30) = 29.75$, $p < .001$, $eta^2 = .51$. Simple contrasts showed that Non-Smokers' mean arousal to the cigarette cue set was significantly lower than their mean arousal to each of the comparison cue sets: Unhealthy Food vs. Cigarettes, $F(1, 29) = 74.43$, $p < .001$, $eta^2 = .72$; Healthy Food vs. Cigarettes, $F(1, 29) = 34.17$, $p < .001$, $eta^2 = .54$; Non-Alcoholic Non-Caffeinated Beverages vs. Cigarettes, $F(1, 29) = 27.65$, $p < .001$, $eta^2 = .49$; Non-Alcoholic Caffeinated Beverages vs. Cigarettes, $F(1, 29) = 19.47$, $p < .001$, $eta^2 = .40$. For Smokers, there was also a main effect for cue type $F(2.8, 269.03) = 39.71$, $p < .001$, $eta^2 = .29$. However, the simple contrasts show that Smokers' mean arousal to cigarettes was significantly higher than their arousal to Healthy food, $F(1, 96) = 20.26$, $p < .001$, $eta^2 = .174$, Non-Alcoholic Non-Caffeinated Beverages $F(1, 96) = 14.43$, $p < .001$, $eta^2 = .13$, and Non-Alcoholic Beverages $F(1, 96) = 36.75$, $p < .001$, $eta^2 = .28$. Furthermore, although Smokers' arousal to cigarettes was still significantly lower than their arousal to Unhealthy Food, $F(1, 96) = 11.36$, $p < .001$, $eta^2 = .11$, the magnitude of this difference was considerably smaller for Smokers versus Non-Smokers.

Alcohol

Because mean arousal to the alcohol and comparison cue sets did not differ between Non-Problem and Problem alcohol users, the multivariate within-subjects contrasts from the original mixed-model MANOVA can be used to examine the differences between the whole sample's mean arousal to Alcohol cues versus the comparison cue sets. There was a significant main effect for cue type $F(3.03, 439.13) = 58.31$ $p < .001$, $eta^2 = .29$. Simple contrasts showed that mean arousal for the Alcohol cue set was significantly lower than mean arousal for the Unhealthy cue set, $F(1, 145) = 130.9$, $p < .001$, $eta^2 = .47$. However, mean arousal to Alcohol cues did not differ significantly from mean arousal to Healthy Food, Non-Alcoholic Non-Caffeinated Beverages, and Non-Alcoholic Caffeinated Beverages: $F(1, 145) = 1.62$, ns; $F(1, 145) = 1.15$, ns; $F(1, 145) = .69$, ns.

Marijuana

For Non / Minimal Users, there was a significant main effect for cue type, $F(3.02, 102.58) = 22.53$, $p < .001$, $eta^2 = .40$. Simple contrasts showed that Non / Minimal Users' mean arousal to the Marijuana cue set was significantly lower than their mean arousal to each of the comparison cue sets: Unhealthy Food, $F(1, 34) = 48.06$, $p < .001$, $eta^2 = .59$; Healthy Food, $F(1, 34) = 25.34$, $p < .001$, $eta^2 = .43$; Non-Alcoholic Non-

Caffeinated Beverages, $F(1, 34) = 17.44$, $p < .001$, $eta^2 = .34$; Non-Alcoholic Caffeinated Beverages, $F(1, 34) = 10.97$, $p < .001$, $eta^2 = .24$. For Non-Problem Users, there was also a significant main effect for cue type, $F(2.49, 102.19) = 21.15$, $p < .001$, $eta^2 = .34$. Simple contrasts showed that Non-Problem Users' mean arousal for the Marijuana cue set was significantly lower than their mean arousal for the Unhealthy Food cue set, $F(1, 41) = 30.94$, $p < .001$, $eta^2 = .43$. However, there were no significant differences between Non-Problem Users' mean arousal for the Marijuana cue set and the remaining three comparison cue sets: Healthy Food, $F(1, 41) = .01$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 41) = .02$, ns; Non-Alcoholic Caffeinated Beverages, $F(1, 41) = .28$, ns. For Problem Users, there was also a significant main effect for cue type, $F(2.22, 160.1) = 23.45$, $p < .001$, $eta^2 = .25$. Simple contrasts showed that Problem Users' mean arousal for the Marijuana cue set was significantly higher than their arousal for the Healthy Food, Non-Alcoholic Non-Caffeinated Beverages, and Non-Alcoholic Caffeinated Beverages, $F(1, 72) = 8.75$, $p = .004$, $eta^2 = .11$; $F(1, 72) = 8.15$, $p = .006$, $eta^2 = .10$; $F(1, 72) = 19.05$, $p < .001$, $eta^2 = .21$. Furthermore, the difference between Problem Users' mean arousal to the Marijuana cue set and the Unhealthy Food cue set was not significant, $F(1, 72) = 7.48$, ns.

Crack Cocaine

For Non / Minimal Users, there was a significant main effect for cue type, $F(2.89, 250.91) = 79.8$, $p < .001$, $eta^2 = .49$. Simple contrasts showed that Non / Minimal Users' mean arousal to the Crack Cocaine cue set was significantly lower than their mean arousal to each of the comparison cue sets: Unhealthy Food, $F(1, 87) = 198.73$, $p < .001$, $eta^2 = .70$; Healthy Food, $F(1, 87) = 68.45$, $p < .001$, $eta^2 = .44$; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 87) = 60.28$, $p < .001$, $eta^2 = .41$; Non-Alcoholic Caffeinated Beverages, $F(1, 87) = 45.85$, $p < .001$, $eta^2 = .35$. For Problem Users, there was a significant main effect for cue type, $F(2.18, 91.49) = 14.56$, $p < .001$, $eta^2 = .26$. Simple contrasts showed that Problem Users' mean arousal to Crack Cocaine cues was significantly lower than their mean arousal to Unhealthy Food cues, $F(1, 42) = 18.66$, $p < .001$, $eta^2 = .31$. However, there was no significant difference between Problem Users' mean arousal to Crack Cocaine cues and the remaining three comparison cue sets: Healthy Food, $F(1, 42) = .75$, ns; Non-Alcoholic Non-Caffeinated Beverages, $F(1, 42) = 1.84$, ns; Non-Alcoholic Caffeinated Beverages, $F(1, 42) = 3.55$, ns.

Arousal Analyses Question 3: Does grouping participants by recent use of a specific drug result in differences in reactivity to cues for that drug, versus reactivity to cues for other drugs?

Cigarettes

Mean arousal ratings for cigarettes and the three other drug cue sets, with the participants grouped by current smoking status, are presented in Figure 12, first panel. As predicted, the Cigarette Use X Cue Type interaction was significant, $F(3, 123) = 11.66$, $p = .001$, $eta^2 = .22$. A follow up between-subjects ANOVA with the four drug

cue types as dependent variables revealed that arousal reactivity to cigarette cues increased significantly between Non-Smokers and Smokers, $F(1, 125) = 69.62$, $p < .001$, while there were no significant differences between Non-Smokers' and Smokers' arousal to the other three drugs: Alcohol, $F(1, 125) = 4.2$, ns; Marijuana, $F(1, 125) = 4.57$, ns; Crack Cocaine, $F(1, 125) = 5.87$, ns.

Alcohol

Mean arousal ratings for Alcohol cues and the three other drug cue sets, with the participants grouped by recent alcohol use, are presented in Figure 12, second panel. As predicted, the Alcohol Use X Cue Type interaction was significant, $F(2.81, 407.9) = 3.02$, $p = .03$, $eta^2 = .02$. However, a follow up between-subjects ANOVA, with mean arousal to each of the four cue types as the dependent variables, showed that there were no differences in arousal reactivity to any of the cue sets between the Non-Problem and Problem alcohol use groups: Alcohol, $F(1, 145) = 4.95$, ns; Marijuana, $F(1, 145) = 1.73$, ns; Crack Cocaine, $F(1, 145) = .44$, ns; $F(1, 145) = .01$, ns.

Marijuana

Mean arousal ratings for marijuana cues and the three other drug cue sets, with the participants grouped by recent marijuana use, are presented in Figure 12, third panel. As predicted, the multivariate Marijuana Use X Cue Type interaction was significant, $F(6, 290) = 9.68$, $p < .001$, $eta^2 = .17$. A follow up between-subjects ANOVA, with mean arousal to each of the four cue types as the dependent variables, revealed that arousal ratings increased as a function of marijuana use only for marijuana cues, $F(2, 147) = 25.15$, $p < .001$, $eta^2 = .26$; there were no significant group differences in arousal ratings for the other three drug cue sets: Cigarettes, $F(2, 147) = .52$, ns; Alcohol, $F(2, 147) = 1.4$, ns; Crack Cocaine, $F(2, 147) = 3.86$, ns.

Crack Cocaine

Mean arousal ratings for Crack Cocaine cues and the three other drug cue sets, with the participants grouped by recent crack cocaine use, are presented in Figure 12, fourth panel. As predicted, the multivariate Crack Cocaine Use X Cue Type interaction was significant, $F(3, 127) = 14.74$, $p < .001$, $eta^2 = .26$. Follow up between-subjects ANOVAs revealed that arousal ratings increased as a function of crack cocaine use only for crack cocaine cues, $F(1, 63.7) = 18.72$, $p < .001$; however, there were no significant group differences in arousal ratings for the other three drug cue sets: Cigarettes, $F(1, 129) = .39$, ns.; Alcohol, $F(1, 129) = 2.39$, ns.; Marijuana, $F(1, 129) = 3.68$, ns.

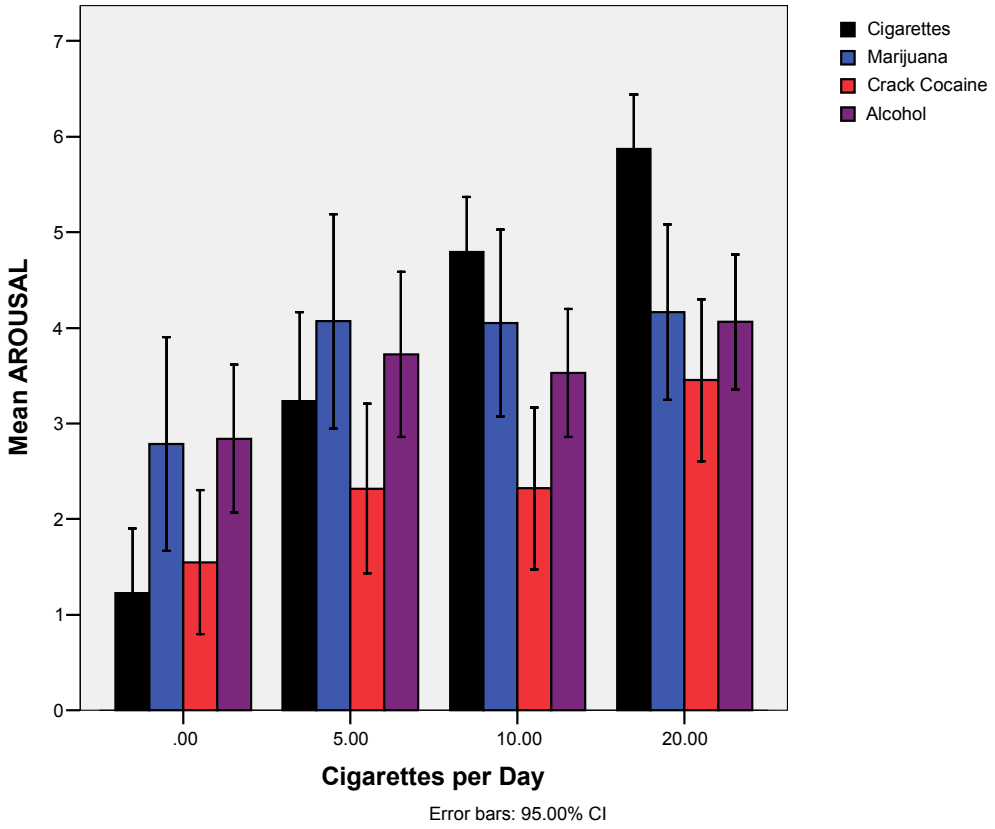

Figure 12: Arousal – Drug vs. Other Drugs

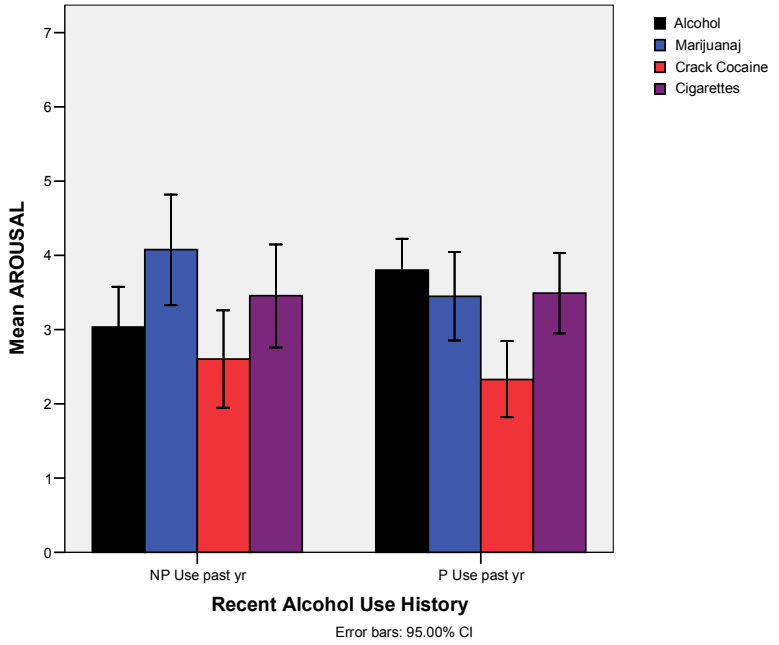

Figure 12: Continued.

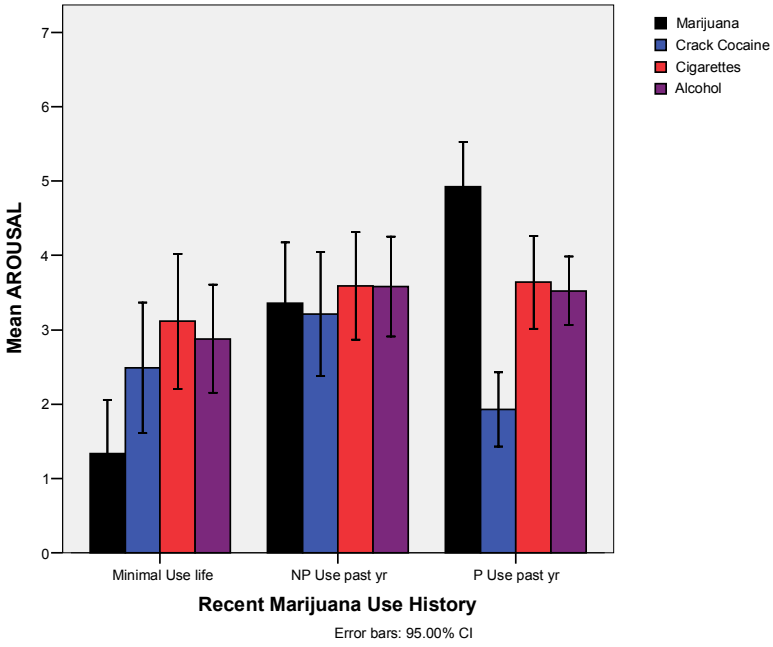

Figure 12: Continued.

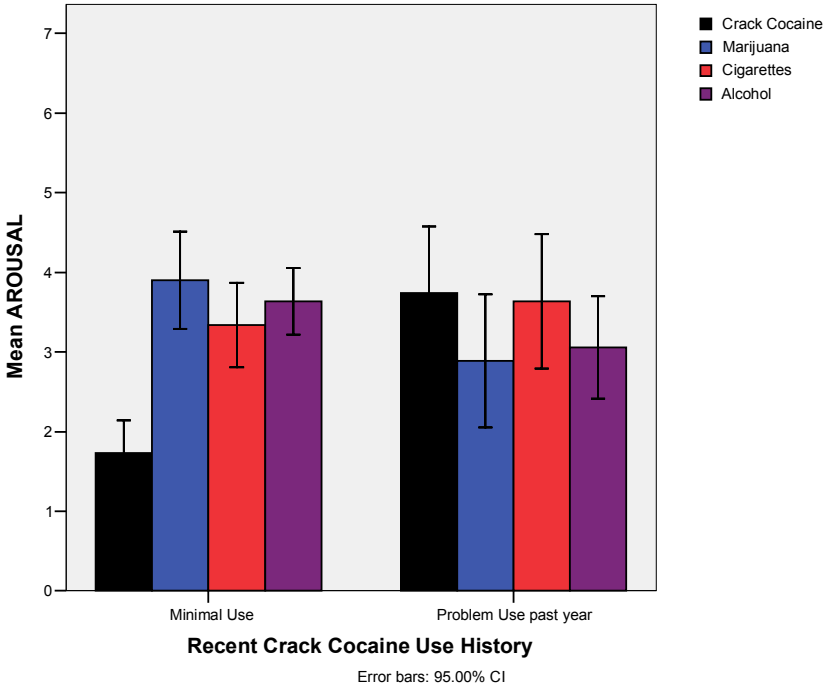

Figure 12: Continued.

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