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The Relationship between Lack of Control and Illusory Pattern Perception among At-Risk
Gamblers and At-Risk Cannabis Users

by

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ABSTRACT

Undergraduate students were recruited based on their frequency of gambling and cannabis use and illusory pattern perception was assessed following random assignment to either a lack-of-control or control condition. In the lack-of-control condition, a sense of lack of control was experimentally induced, whereas the control condition served as a baseline. Based on gambling and cannabis use problem severity, participants ($N = 218$) were categorized as either at-risk gamblers, at-risk cannabis users, pure controls, non-pure controls, or at-risk comorbid participants. While no group effect was observed, the results partially replicated the findings of Whitson and Galinsky (2008), whereby relative to the control condition, participants in the lack-of-control condition tended to perceive more illusory patterns; as well as more real patterns. The results are discussed with respect to avenues for future research.

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DEDICATION

To my mother, Heidi Stea—with the purest and deepest love, in spite of the fact that I don't say it well.

And in memory of my Nonno, Vito Stea.

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LIST OF ABBREVIATIONS

ANRP	– Accuracy in identifying Non-Real Patterns
ARP	– Accuracy in identifying Real Patterns
ASSIST	– Alcohol, Smoking, and Substance Involvement Screening Test
AUC	– Area Under the Discounting Curve
AUDIT	– Alcohol Use Disorders Identification Test
BIDR	– Balanced Inventory of Desirable Responding
BFAS	– Big Five Aspects Scale
BFI	– Big Five Inventory
BSI	– Brief Symptom Inventory
CBT	– Cognitive Behavioral Therapy
CPGI	– Canadian Problem Gambling Index
DD	– Delay Discounting
DNRP	– Detection of Non-Real Patterns
DRP	– Detection of Real Patterns
EGM	– Electronic Gaming Machine
FFM	– Five-Factor Model
GCI	– Gambling Cognitions Inventory
GSI	– Global Severity Index
GSUQ	– Gambling and Substance Use Questionnaire
IM	– Impression Management
MCAR	– Missing Completely At Random

MVA – Missing Values Analysis

NEO PI-R – NEO Personality Inventory Revised

NT – Noise Task

PGSI – Problem Gambling Severity Index

PI – Positive Identifications

PNS – Personal Need for Structure Scale

RPS – Research Participation System

SDE – Self-Deceptive Enhancement

SOGS – South Oaks Gambling Screen

SPQ-B – Schizotypal Personality Questionnaire; Brief Version

SPT – Snowy Pictures Task

TA – Total Accuracy

VLT – Video Lottery Terminal

EPIGRAPH

They'll always tell you how much they've won, never how much they've lost.

Lou Stea

INTRODUCTION

For many people gambling is a form of recreation with no associated negative consequences; for others, gambling can become a disordered or diseased state that deviates from normal, healthy behaviour. In the past two decades, the field of gambling has grown substantially as researchers have come to identify a multitude of predictive risk factors associated with the development of pathological gambling (National Research Council, 1999). The experience of cognitive distortions in particular is one risk factor thought to contribute to the development and maintenance of problem gambling behaviour (Delfabbro & Winefield, 2000; Ladouceur & Walker, 1996; Sharpe & Tarrier, 1993; Sylvain, Ladouceur, & Boisvert, 1997; Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997). Indeed, research has suggested that the frequency and intensity of various gambling-related cognitive distortions are associated with gambling frequency and problem severity (Gilovich, 1983; Ladouceur, 2004; Joukhador, Blaszczynski, & Maccallum, 2004; Joukhador, Maccallum, & Blaszczynski, 2003; Moore & Ohtsuka, 1999; Xian et al., 2008). Unfortunately, there is a paucity of research investigating the mechanisms that connect cognitive distortions to gambling pathology. As a result, what remains unclear is the extent to which gambling-related cognitive distortions arise specifically due to the factors involved in gambling behaviour alone, whether they are symptomatic of addictive behaviours more generally, or whether they are symptomatic of general distress or dysfunction (Ferguson, 2003; Van Brunschot, 2009). By the same token, it is also unclear as to whether problem gamblers exhibit global cognitive distortions or whether their distortions are primarily confined to the domain of gambling. An understanding of the moderating and mediating factors that contribute to gambling-related cognitive distortions

is important in order to shed light on intervention strategies that directly aim to reduce these distortions, and consequently, indirectly reduce gambling pathology.

The experience of lack of control is one factor that has been found to increase a specific kind of cognitive distortion (i.e., illusory pattern perception) among non-gamblers (Whitson & Galinsky, 2008). As it turns out, lack of control is not only relevant during participation in gambling-related activities that are based on chance, but the factor is also thought to be a defining phenotypic feature of addictive behaviours more generally. In this vein, if a global sense of lack of control is heightened among addicted individuals, then there is reason to suspect that addicted individuals, including problem gamblers, will tend to demonstrate greater cognitive distortions during everyday life (i.e., not solely during participation in gambling-related activities) relative to non-addicted individuals. To this end, the present study sought to investigate whether experimentally inducing lack of control served to increase and exacerbate illusory pattern perception among a group of at-risk problem gamblers and among a group of at-risk cannabis abusers relative to a group of non-gamblers and non-cannabis users.

Cognitive Distortions among Gamblers

In surveying the literature, Toneatto (1999) has identified a multitude of gambling-related cognitive distortions that are present during gambling. These include the magnification of gambling skills, minimization of other gambler's skills, superstitious beliefs (including talismanic, behavioural, and cognitive superstitions), interpretive biases (including internal attributions, external attributions, the gambler's fallacy, chasing of losses, anthropomorphism, reframed losses, and hindsight bias), temporal telescoping, selective memory, predictive skill, illusions of control over luck (including luck as an

uncontrollable variable, luck as a controllable variable, luck as a trait variable, and luck as a contagion), and illusory correlations. The pervasiveness of cognitive distortions during gambling is in part highlighted by Delfabbro and Winefield (2000) who found that irrational cognitions constituted as much as 75% of all gambling-related thoughts during electronic gaming machine (EGM) play in standard gaming venues. Interestingly, Benhsain, Taillerfer, and Ladoucer (2004) found that among players who indicated that they understood that the outcome of a game is randomly determined, 70% still reported experiencing irrational cognitions during play. These studies underscore the heterogeneous, prevalent, and robust nature of cognitive distortions experienced during gambling.

The misunderstanding of probability principles and the experience of gambling-related cognitive distortions can occur among both non-problem and problem gamblers (Kelly, Skinner, Wiebe, Turner, & Nora, 2001; Langer, 1983). However, not surprisingly, research has demonstrated that the frequency and intensity of cognitive distortions are associated with both gambling frequency and gambling problem severity (Delfabbro & Winefield, 2000; Gilovich, 1983; Joukhador et al., 2004; Joukhador et al., 2003; Ladouceur, 2004; Moore & Ohtsuka, 1999; Xian et al., 2008). The substantive role of cognitive distortions in the etiology of gambling pathology is further evidenced by the success of cognitive and cognitive-behavioral therapies (CBT) for problem gambling, which focuses on identifying and challenging cognitive distortions about gambling (Ladouceur et al., 2001; Toneatto, 2002). Indeed, CBT has garnered the most empirical support in the treatment and management of problem gambling (e.g., Echeburua, Baez, & Fernandez-Montalvo, 1996; Ladouceur et al., 2001, 2003; Petry et al., 2006; Sylvain et al., 1997) relative to other psychosocial treatment modalities (Hodgins & Holub, 2007).

Nevertheless, there remains a dearth of research investigating the exact mechanisms by which cognitive distortions exert their influence over gambling behaviour. Thus far, many of the explanatory models put forth emphasize the importance of the pattern of wins or losses during play (for a brief overview see Monaghan, Blaszczynski, & Nower, 2009), and empirical support for these models is inconsistent. No research has examined the relationship of cognitive distortions to addiction variables beyond that of proximal or distal play outcomes with respect to the development and maintenance of gambling pathology. Examining the relation of other addiction variables (e.g., the experience of lack of control) to cognitive distortions might aid in understanding the etiology of gambling pathology and addictive behaviours more generally. Indeed, examining cognitive distortions by merely focusing on their relation to play outcomes is limited because the relationship between distortions and outcomes cannot fully account for why only some, and not all, individuals who are subjected to particular patterns of wins and losses experience a greater number and/or intensity of cognitive distortions and develop gambling problems. Individuals who experience a greater degree of lack of control in their lives might be more vulnerable to cognitive distortions, irrespective of the effects of play outcomes, and consequently, might be more vulnerable to gambling pathology.

Cognitive Distortions among Cannabis Users

It has been well established that acute cannabis intoxication impairs cognitive processes. Alterations in various cognitive and behavioural abilities such as memory, attention, reaction time, concept formation, motor coordination, and perception have been well documented (Abood & Martin, 1992; D'Souza et al., 2004; Morrison et al., 2009). Although the extent and duration of these alterations remains unclear, there is an increasing

body of evidence demonstrating that cannabis users show persistent deficits in specific cognitive functions beyond the period of acute intoxication (Solowij & Michie, 2007). Given the similarities between these alterations and the many symptoms of schizophrenia, a wealth of research has been produced with the aim of uncovering a link between cannabis use and the development of psychosis (Arseneault, Cannon, Witton, & Murray, 2004; Hall & Dagenhardt, 2000; Smit, Bolier, & Cuijers, 2004). Indeed, cognitive dysfunction associated with cannabis use is similar in many respects to the cognitive endophenotypes that have been proposed as vulnerability markers of schizophrenia (Solowij & Michie, 2007), such as neurocognitive deficits in working memory and selective attention (Solowij, 1995; Fletcher et al., 1996; Pope & Yurgelun-Todd, 1996). A growing body of evidence has supported the hypothesis that cannabis use may precipitate or exacerbate psychosis in vulnerable individuals, with a series of longitudinal studies finding an increased risk of psychosis among cannabis users after controlling for confounding factors (Arseneault et al., 2002; Fergusson, Horwood, & Ridder, 2005; Fergusson, Horwood, & Swain-Campbell, 2003; van Os et al., 2002; Zammit, Allebeck, Andreasson, Lundberg, & Lewis, 2002). Thus, evidence for a causal link from cannabis use to psychosis is accumulating (Barkus & Murray, 2010; Henquet, Murray, Linszen, & van Os, 2005; Moore et al., 2007).

Most relevant to the purposes of the present study is the evidence linking cannabis use to schizotypal personality (Dumas et al., 2002; Kwapil, 1996; Mass, Bardong, Kindl, & Dahme, 2001; Schiffman, Nakamura, Earleywine, & LaBrie, 2005; Skosnik, Spatz-Glenn, & Park, 2001; Williams, Wellman, & Rawlins, 1996). Collectively, these findings support the notion that past and current cannabis users exhibit higher levels of schizotypal personality traits (e.g., suspiciousness, magical thought, unusual perceptual experiences)

than individuals who have never used cannabis. Findings from Dumas et al. (2002) and Schiffman et al. (2005) specifically suggest that regular cannabis users in student populations are significantly more prone to cognitive and perceptual distortions as well as disorganization, but not interpersonal deficits, than non-regular users and those who have never used.

While the research shows that cannabis users have a propensity to experience cognitive distortions beyond the period of acute intoxication, the exact mechanisms driving these distortions remain unclear. That is, it is unclear as to whether the cognitive distortions exhibited among cannabis users are the result of the non-acute pharmacological effects of cannabis, whether they stem from the schizotypal characteristics of a sub-population of cannabis users, whether they are the result of addiction variables (e.g., the experience of lack of control), whether they are the result of general distress or dysfunction, or whether or how these factors interact. Investigations of recovery of cognitive function with abstinence from cannabis have produced conflicting evidence with some studies suggesting full recovery after 28 days of abstinence, others showing partial early recovery after a mean two years abstinence, and still others finding no recovery after 25 to 28 days of abstinence (see Solowij & Michie, 2007). Thus, in order to better elucidate the etiology of cannabis use disorders, comprehensive investigations are warranted, including examinations of the relationships between cognitive distortions, cannabis use, and addiction variables, such as the experience of lack of control. Unlike the gambling literature, however, there is currently no research investigating whether cognitive distortions are actually involved in the development and maintenance of cannabis use disorders.

The Role of Lack of Control in Cognitive Distortions

Whitson and Galinsky (2008) advance the notion that the desire to combat uncertainty and maintain control is a fundamental human motivation. They contend that the experience of lack of control is an anxiety-provoking and aversive state, which activates the amygdala, thereby signalling a fear response. In this light, it is no wonder that individuals are motivated to regain control when it is taken away. Interestingly, Whitson and Galinsky argue that when individuals are unable to gain a sense of control objectively, they will attempt (unconsciously or consciously) to gain it cognitively or perceptually. Indeed, these authors found that experimentally manipulating lack of control increased a specific type of cognitive distortion, namely, illusory pattern perception (i.e., the identification of a coherent and meaningful interrelationship among a set of random or unrelated stimuli), among non-addicted individuals. Specifically, Whitson and Galinsky employed a series of six experiments whereby they manipulated lack of control in undergraduate students by using either a concept-identification computer task that provided either random feedback to participant responses (lack-of-control condition) or no feedback (control condition), or by having participants vividly recall an experience in which they lacked or had full control over a situation. The authors found that relative to control participants, participants in the lack-of-control conditions were significantly more likely to report a need for structure, to perceive images in pictures where in fact no images existed, to endorse superstitious perceptions and conspiracies, and to perceive illusory correlations in stock market information. The authors also found that when participants were made to feel more psychologically secure after lacking control, they were less prone to the perception of illusory patterns.

While Whitson and Galinsky (2008) operationalized a kind of proximal lack of control in their experimental paradigm, the clinical phenomenon of lack of control is widely regarded as a defining phenotypic feature of addictive behaviours (McCusker, 2001). Specifically, lack of control with respect to addictions can be conceptualized as the continuation of, or excessive engagement in an addictive behaviour, despite the negative consequences and/or intentions to abstain from, or moderate the behaviour. In this sense, lack of control as a global, more distal characteristic spans both pharmacological and behavioural addictions and can be described from multiple levels of analysis; from the neuropsychological (i.e., lack of control resulting from powerful dopaminergic circuitry hijacking the brain, Panksepp, 1998; Swanson, 2000) to the phenomenological (i.e., lack of control manifesting as a subjective feeling of a loss of volition while engaging in addictive behaviours, Kaminsky, 2004). Lack of control with respect to addictions represents a failure to gain control over addictive behaviours, and consequently, individuals suffering from addictive behaviours should hypothetically experience a greater degree of lack of control in their everyday lives. In this vein, and in light of Whitson and Galinsky's findings, addicted individuals might be expected to be more vulnerable to cognitive distortions in order to regain a sense of control. Interestingly, no research has examined exactly whether or how lack of control contributes to the development or maintenance of addictive behaviours, and no research has examined whether or how lack of control is associated with cognitive distortions among individuals with addictive behaviour problems.

THE PRESENT STUDY

Rationale

The present study was predicated on three main assumptions: (1) Illusory pattern perception is a kind of cognitive distortion. (2) Lack of control increases illusory pattern perception (Whitson & Galinsky, 2008), and by extension, cognitive distortions. (3) Individuals with addictive behaviour problems have a greater degree of lack of control in their everyday lives.

Based on the assumptions above, the primary aim of the present study was to investigate whether the link between lack of control and illusory pattern perception is heightened or exacerbated among individuals with gambling and cannabis use problems in particular, and addictive behaviour problems more generally. It is especially important to understand the link between lack of control and cognitive distortions in the context of gambling problems in light of the notion that lack of control is experienced both during gambling activities as well as during attempts at abstaining or moderating gambling; and the link is important to understand because cognitive distortions are thought to be etiological risk factors in the development and maintenance of problem gambling.

Overview

The present study followed some of the methods employed by Whitson and Galinsky (2008) in order to manipulate lack of control and measure illusory pattern perception. Specifically, lack of control was manipulated by employing the Concept-Identification Task (Pittman & Pittman, 1979; Whitson & Galinsky, 2008), which provided either random feedback to participant responses in order to induce feelings of lack of control (i.e., the lack-of-control condition), or no feedback in order to obtain baseline responses without feelings of lack of control (i.e., the control condition). Illusory pattern perception was assessed using the Snowy Pictures Task (Ekstrom, French, Harman, &

Derman, 1976; Whitson & Galinsky, 2008) and the Noise Task (Whitson & Galinsky, 2008). In addition, the Personal Need for Structure Scale (PNS; Neuberg & Newsom, 1993) was treated as a dependent variable in order to measure whether manipulation of lack of control served to increase the desire for structure.

At-risk gamblers and at-risk cannabis users were chosen as the primary experimental groups and were compared to a pure control group, a non-pure control group, and an at-risk comorbid group. Both the at-risk gambling group and the at-risk cannabis use group were hypothesized to be more vulnerable to cognitive distortions because their respective propensity towards addictive behaviours should hypothetically confer a greater degree of lack of control in their everyday lives. Finally, the inclusion of both an at-risk gambling group and an at-risk cannabis use group allowed for the comparison of outcomes between a behavioural addiction group and a pharmacological addiction group, respectively.

Hypotheses

The hypotheses were predicated on a model that postulated two types of lack of control: proximal and distal. Proximal lack of control refers to lacking control over outcomes present in the immediate situation, which dissipates with time. For example, lacking control over the outcomes of a slot machine is proximal and dissipates soon after play is stopped. Distal lack of control refers to lacking control over outcomes that are more persistent and long-term. For example, consistently lacking control over moderating daily cannabis use is distal, which does not dissipate with time unless control over the situation is implemented. It is proximal lack of control that was experimentally induced in the present study, and distal lack of control that was assumed to be a priori heightened (i.e., elevated

before participation in the present study) among individuals with gambling and cannabis use problems.

Undergraduate students were classified into either an at-risk gambling group, an at-risk cannabis group, a pure control group, a non-pure control group, or an at-risk comorbid group. The results were hypothesized to be consistent with a two-hit mechanism whereby relative to pure control participants, both at-risk gamblers and at-risk cannabis users would exhibit a greater degree of illusory pattern perception due to their greater levels of distal lack of control in their lives (i.e., the first hit), and illusory pattern perception would be further exacerbated in the lack-of-control condition relative to the control condition, when proximal lack of control was experimentally manipulated (i.e., the second hit). Moreover, consistent with the findings from Whitson and Galinsky (2008), it was expected that pure control participants would only be affected by proximal lack of control (i.e., the second hit where lack of control was experimentally induced), and would therefore demonstrate more illusory pattern perception in the lack-of-control condition relative to the control condition, but less illusory pattern perception overall relative to both at-risk gamblers and at-risk cannabis users.

In statistical terms, two main effects were hypothesized. The first main effect was a condition effect whereby all participants were expected to demonstrate greater levels of illusory pattern perception in the lack-of-control condition relative to the control condition. The second main effect was a group effect whereby the at-risk gambling group and the at-risk cannabis use group were expected to demonstrate greater levels of illusory pattern perception relative to the pure control group. In this sense, the relationship between lack of

control and illusory pattern perception was expected to be exacerbated among at-risk gamblers and at-risk cannabis users relative to pure control participants.

In addition, following Whitson and Galinsky (2008), it was hypothesized that a main effect for condition would be revealed on participants' need for structure, whereby participants in the lack-of-control condition would demonstrate an increased desire for structure compared to participants in the control condition.

There was no reason to presume that at-risk gamblers would differ from at-risk cannabis users with respect to the degree of illusory pattern perception endorsed. On the one hand, both groups hypothetically share the same level of lack of control in their everyday lives (i.e., distal lack of control) by virtue of being classified as above moderate-risk for addiction problems, and therefore, there was no reason to suspect that one addiction afforded a greater degree of lack of control over the other. On the other hand, it was difficult to ascertain whether or not the problem severity measures used in the present study to classify at-risk gambling and at-risk cannabis use could be equated, and therefore, a confident hypothesis regarding differences between these two groups was not made.

Since the inclusion of a non-pure control group and an at-risk comorbid group was made post-hoc (i.e., after data collection but before data analyses), no hypotheses were postulated regarding these groups. Finally, while space constraints preclude an explication of the rationales, several exploratory hypotheses were made using the descriptive and exploratory measures—the presentation, results, and brief discussion of which can be found in Appendix A and Table A1.

METHOD

Participants

Recruitment Method. The intention was to recruit frequent gamblers and cannabis users because frequency of gambling and cannabis use was to be used as a proxy for problem severity of gambling and cannabis use, respectively. Indeed, frequent gambling and frequent cannabis use are not isomorphic with problem gambling and cannabis use problems, respectively. However, frequency of gambling has been found to be correlated with the risk of problem gambling (Currie et al., 2006; Weinstock, Whelan, & Meyers, 2004) and frequency and quantity of cannabis use has been found to be linearly associated with being dependent on cannabis (Chen, Kandel, & Davies, 1996). In this vein, frequent gamblers and frequent cannabis users were recruited because frequency of gambling and cannabis use was likely to approximate problem gambling and cannabis use problems, respectively, and to be indicative of distal levels of lack of control. Thus, as opposed to frequency, problem severity was in fact the variable of interest due to its closer connection to the kind of lack of control thought to be associated with addictive behaviour problems.

Advertisements on the Department of Psychology's online Research Participation System (RPS) were used to recruit participants whereby students would receive bonus credit towards a psychology course in exchange for their participation. Three separate advertisements on the RPS were used with the intention of recruiting 50 frequent gamblers, 50 frequent cannabis users, and 50 control participants (Appendix B).

A total sample size of 50 participants in each group was deemed sufficient in order to obtain medium to large effect sizes in light of the study by Whitson and Galinsky (2008), which obtained medium to large effect sizes by using total sample sizes of undergraduate students ranging from 25 to 36 in experiments that employed the same independent and dependent measures that were used in the present study. In addition, a total sample size of

50 participants per group was desirable in order to obtain medium to large effect sizes in light of an a priori power analysis based on Cohen (1992), which indicated that for a three-group Analysis of Variance (ANOVA) at an alpha of .05, the necessary sample size for power of .80 was 52 per group to detect a medium effect size, and 21 per group to detect a large effect size; and for a two-group ANOVA at an alpha of .05, the necessary sample size for power of .80 was 64 per group to detect a medium effect size, and 26 per group to detect a large effect size.

To recruit frequent gamblers, participants were told that in order to be eligible for the study, they must “gamble in some form [e.g., spending money on casino slot machines, video lottery terminals (VLTs), BINGO, card or board games with family or friends (for money), gambling on the internet, sports select (e.g., Pro Line, Point Spread), sports pools, horse races, etc.] at least 4 or more times per month [NOT INCLUDING playing lottery tickets such as 649 or Super 7, instant-win or scratch tickets].” It was expected that recruitment of frequent gamblers would be feasible in light of the Canadian Campus Survey 2004’s (Adlaf, Demers, & Gliksman, 2005) findings, which indicated that 5.3% of undergraduate students reported gambling at least weekly and based on the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001), 7.9% of all students were identified to be at-risk for developing serious gambling problems, 2.7% with moderate problems, and 1.0% with severe problems.

Similarly, to recruit frequent cannabis users, participants were told that in order to be eligible for the study, they must “use cannabis in some form (e.g., marijuana, hash) at least 4 or more times per week.” It was expected that recruitment would be feasible in light

of the Canadian Campus Survey 2004's (Adlaf et al., 2005) findings, which indicated that among students who used cannabis in the past year, about 6.3% reported daily use.

To recruit control participants, participants were told that in order to be eligible for the study, they must “NOT have gambled in any form [e.g., spending money on casino slot machines, video lottery terminals (VLTs), lottery tickets such as 649 or Super 7, instant-win or scratch tickets, raffle tickets or fundraising tickets, BINGO, card or board games with family or friends (for money), gambling on the internet, sports select (e.g., Pro Line, Point Spread), sports pools, horse races, etc.] or used cannabis in any form (e.g., marijuana, hash) in the last 60 days.” Abstinence from gambling and cannabis use for 60 days was chosen as a criterion in order to increase the probability of recruiting a relatively pure control group.

Failure of the Recruitment Method. Despite the initial goal of recruiting a total of 150 participants, 222 students (i.e., almost a 50% increase) participated in the study in an attempt to compensate for the failure of the recruitment method. The recruitment method failed in the sense that a substantial number of students signed-up for participation despite not meeting the intended gambling, cannabis use, and control group frequency eligibility requirements as indicated by an examination of their respective responses to question 1 on the GSUQ and question 1 on the ASSIST. Of the 80 participants that signed-up for the frequent gambling group, only 41 participants (51.2%) reported engaging in some form of gambling (not including playing lottery tickets) equal to or greater than *about once/week*. Similarly, of the 73 participants that signed-up for the frequent cannabis use group, only 28 (38.4%) reported *daily or almost daily* cannabis use in the past three months on the ASSIST. Finally, of the 69 participants that signed-up for the control group, 66 (95.7%)

reported engaging in some form of gambling (not including playing lottery tickets) less than or equal *1-5 times/year* and using cannabis less than or equal to *once or twice* in the past three months on the ASSIST. It should be noted that participants were not explicitly asked if they met the specific written eligibility requirements on the RPS. Thus, for a number of reasons (see Appendix C), students signed-up for participation in the study despite not meeting the intended eligibility requirements.

In any event, since recruitment based on frequency of gambling and cannabis use was intended to be used as a proxy for problem severity of gambling and cannabis use, respectively, it would have been wiser to use an alternative recruitment method whereby participants would be carefully prescreened for levels of problem severity before they were eligible to participate. However, the initial decision to recruit based on frequency was made for both practical and ethical reasons. Practically, given the limited time frame of the study, it was thought that recruitment based on frequency would facilitate quicker recruitment rates and be more attractive to gamblers and cannabis users as compared to a two-stage recruitment method. Ethically, prescreening students for use of an illegal substance (i.e., cannabis) presented ethical challenges on the RPS, since any researcher on the RPS system (i.e., researchers not involved in the present study) is granted access to the prescreen responses of all participants. Fortunately, however, enough data were collected in the study to a priori (i.e., before statistical analyses of the hypotheses) reformulate the participant groups such that they were more consistent with the recruitment intentions and the study hypotheses (i.e., five new groups were created based on problem severity, as opposed to comparing three groups based on frequency of gambling and cannabis use).

Categorization of Participants. In light of (1) the failure of the recruitment method, (2) the desire to utilize the entire sample size for statistical analyses, (3) the desire to account for comorbidity of gambling and cannabis use problems, and (4) the intention of recruiting participants based on frequency of gambling and cannabis use as a proxy for problem severity, it was decided that the most conceptually appropriate course of action would be to reformulate the originally proposed 3 groups that were based on frequency (i.e., frequent gamblers, frequent cannabis users, and control participants) to 5 new groups based on problem severity (i.e., at-risk gamblers, at-risk cannabis users, pure controls, non-pure controls, and at-risk comorbid participants). The at-risk gambling group was created by grouping participants together that reported above moderate-risk gambling problem severity on the PGSI (i.e., total scores greater than or equal to 3) and less than moderate-risk cannabis use problem severity on the ASSIST (i.e., total scores less than 4). Similarly, the at-risk cannabis use group was created by grouping participants together that reported above moderate-risk cannabis use problem severity on the ASSIST (i.e., total scores greater than or equal to 4) and less than moderate-risk gambling problem severity on the PGSI (i.e., total scores less than 3). While both the pure and non-pure control groups were created by grouping participants together that reported below moderate-risk problem severity of both gambling and cannabis use, the pure control group was created by grouping participants together that had total scores of 0 on both the PGSI and the ASSIST, whereas the non-pure control group was created by grouping participants together that had scores of less than 3 on the PGSI, and less than 4 on the ASSIST, but not scores of 0 on both measures. Finally, the at-risk comorbid group was created by grouping participants together that reported above moderate-risk problem severity of both gambling and cannabis use.

Participants were initially 222 undergraduate students taking at least one psychology course in the Department of Psychology at the University of Calgary. Four participants were excluded from analyses because they reported using cannabis within the past 12 hours prior to participation in the study. Thus, analyses were conducted on the remaining 218 participants (36.7% male; age range = 17 – 48; M age = 21.3 years, SD = 4.39); from which 35 (16.1%) participants were categorized as at-risk gamblers, 42 (19.3%) as at-risk cannabis users, 67 (30.7%) as pure controls, 44 (20.2%) as non-pure controls, and 30 (13.8%) as at-risk comorbid participants. The sample size for each group was deemed sufficient according to Whitson and Galinsky's (2008) study, which obtained medium to large effect sizes by using total sample sizes of undergraduate students ranging from 25 to 36 in experiments that employed the same independent and dependent measures that were used in the present study. In addition, the sample size for each group was deemed sufficient according to an a priori power analysis based on Cohen (1992), which indicated that for a five-group ANOVA at an alpha of .05, the necessary sample size for power of .80 is 39 per group to detect a medium effect size, and 16 per group to detect a large effect size.

Lack of Control Manipulation

The concept-identification task (Pittman & Pittman, 1979; Whitson & Galinsky, 2008) was used to manipulate lack of control and was conducted on a computer. Participants were given the instructions on the computer, which were presented on two consecutive screens (Appendix D). It should be noted that the wording of the instructions deviated from the wording used in Whitson and Galinsky in an attempt to make the instructions clearer.

After participants read both screens of instructions, the researcher orally reiterated the instructions and then watched as participants completed a practice block consisting of 10 trials (see Appendix E for an example screen shot of a trial). For all participants, the practice block was programmed to be the exact same and had the *dotted underline* as the correct value (note that only in the practice block did a correct value actually exist). Participants were not permitted to begin the real task until the researcher believed that the task was fully understood by the participants.

After completion of the practice block, participants completed the real task, which consisted of 4 blocks, each with 10 trials. Following each block, participants were asked to select on the keyboard what they believed was the correct value for that block (Appendix F), and were given no feedback concerning their answer.

In the lack-of-control condition, participants received random feedback following each trial. That is, the feedback was a priori programmed into the computer such that participants received feedback that was non-contingent to their responses on each trial. Each block contained 5 correct feedback responses and 5 incorrect feedback responses (Appendix G), such that 50% of the time the computer told participants that their response had been correct and 50% of the time the computer told participants that their response was incorrect. In fact, there were no correct or incorrect values chosen (except on the practice trial), and therefore, participants were unable to correctly learn an answer. For the last trial across all four blocks, the computer was programmed to indicate that participant responses were incorrect. Following completion of each block and the selection of the value participants believed was correct, participants were presented with instructions to complete

the subsequent block (Appendix H). Every participant in the lack-of-control condition received the exact same order of both stimuli and computer feedback across all four blocks.

In the control condition, participants received an additional instruction screen (not viewed by participants in the lack-of-control condition) following completion of the practice block (Appendix I), and completed the real task without receiving any computer feedback whatsoever. During the real task, following completion of each block and the selection of the value participants guessed as correct, participants were presented with instructions to complete the subsequent block that differed from the corresponding instructions received by participants in the lack-of-control condition (Appendix J). Every participant in both the lack-of-control and control conditions received the exact same order of stimuli across all four blocks.

Dependent Measures

Illusory Pattern Perception Tasks. There were two illusory pattern perception tasks. The first task was Whitson and Galinsky's (2008) paper-and-pencil modified version of the Snowy Pictures Task (SPT; Ekstrom, French, Harman, & Derman, 1976; Appendix K), whereby a series of 24 snowy pictures--pictures that are grainy and granulated so that is difficult to make out an image in them--were presented to participants, with half of the pictures manipulated using digital media software such that no traces of the original image remained. The task and instructions were presented to participants in the exact same manner as in Whitson and Galinsky, with the exception of the present study presenting the word *anchor* as an answer to the first sample item in the instructions. Essentially, the task involved participants viewing and describing all 24 pictures by either writing *one or two* words to describe a picture in which an image was perceived or writing the word *none* to

describe a picture in which no image was perceived. Whitson and Galinsky used the SPT to derive a measure of illusory pattern perception by measuring the total number of images perceived among the 12 pictures that lacked an image; I have labelled this variable Detection of Non-Real Patterns (DNRP). They also compared responses on the SPT by measuring the total number of images perceived among the other 12 pictures in which an image did exist; I have labelled this variable Detection of Real Patterns (DRP). However, the authors did not sum across these variables to yield a measure of total positive identifications of images among the 12 pictures that lacked an image and among the other 12 pictures that contained a real image; I have labelled this variable Positive Identifications (PI). All three variables are useful for investigating the effects of lack of control in light of the notion that lack of control might increase the probability of detecting both real and non-real patterns, and not exclusively the latter.

In addition, Whitson and Galinsky (2008) did not measure whether participants were accurate in identifying the 12 pictures that lacked an image (I have labelled this variable Accuracy in identifying Non-Real Patterns; ANRP) or in identifying the 12 pictures that contained a real image (I have labelled this variable Accuracy in identifying Real Patterns; ARP), and therefore they did not sum these variables to yield a measure of total accuracy on the SPT (I have labelled this variable Total Accuracy; TA). In light of the notion that lack of control might not only increase the probability of detecting both real and non-real patterns, but also increase the accuracy of detecting both real and non-real patterns, an examination of these corresponding three accuracy variables (i.e., ANRP, ARP, and TA) is important in order to dissociate pattern detection effects from accuracy effects.

The second task employed to measure illusory pattern perception was Whitson and Galinsky's (2008) Noise Task (NT; Appendix L), whereby participants were presented with 10 pictures of randomly generated noise on a computer screen. The pictures were of unstructured white noise, essentially a tightly-packed scattering of black dots on a white background that resembled static on an empty channel of a television set. Since each of the 10 pictures were of random static, in which no image existed, any identification from a participant that they had seen an object in the picture was evidence of illusory pattern perception. The 10 pictures were presented to all participants one at a time in the same order. After viewing each picture, participants were required to indicate if they saw an object in the picture by responding *yes* or *no* using the keyboard. Immediately after a response was provided, the next picture was displayed. As opposed to Whitson and Galinsky, which used a paper-and-pencil version of the NT, the present study employed a computerized version of the NT, which allowed for the recording of response latencies following each response for exploratory purposes.

Personal Need for Structure Scale (PNS; Neuberg & Newsom, 1993; Appendix M). Following Whitson and Galinsky (2008), the PNS was used to measure the need to structure the world into a simplified, more manageable form. The 11-item measure was used to test whether lacking control increased the desire for structure, which relates to pattern perception in its search for simplified structures in the environment. The PNS has demonstrated sufficient reliability and convergent and discriminant validity among undergraduate students (Neuberg & Newsom, 1993).

Descriptive Measures

The following descriptive measures were used in the present study: Demographics Questionnaire (Appendix N); Gambling and Substance Use Questionnaire (GSUQ; Appendix O); Problem Gambling Severity Index (PGSI; Appendix P; from the Canadian Problem Gambling Index; CPGI; Ferris, Wynne, & Single, 1999); the Alcohol, Smoking, and Substance Involvement Screening Test, Cannabis Section (ASSIST; WHO ASSIST Working Group, 2002; Appendix Q); the Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Appendix R); and the Brief Symptom Inventory (BSI; Derogatis, 1975). For a brief description of these measures, please refer to Appendix S.

Exploratory Measures

The following exploratory measures were used in the present study: the Delay Discounting task (DD; Holt, Green, & Myerson, 2003; Shead, 2004); the Big Five Aspects Scales (BFAS; DeYoung, Quilty, & Peterson, 2007; Appendix T); the Balanced Inventory of Desirable Responding, Version 6 (BIDR; Paulhus, 1988, 1991); the Gambling Cognitions Inventory (GCI; Holub, 2003; Appendix U); and the Schizotypal Personality Questionnaire, Brief Version (SPQ-B; Raine & Benishay, 1995; Appendix V). For a brief description of these measures, please refer to Appendix W.

Procedure

After responding to the advertisements posted on the RPS, participants were sent a reminder email (Appendix X) to abstain from substances at least 12 hours prior to participating in the study. Upon arriving to the laboratory, participants provided their informed consent (Appendix Y) and were then asked to report if they had used cannabis,

alcohol, or any other substances within the past 12 hours--only 4 participants reported using substances (i.e., cannabis) and their data were excluded from analyses.

Participants were randomly assigned to either the lack-of-control or control conditions and then completed the concept-identification task. Following completion of the concept-identification task, participants completed the illusory pattern perception tasks (the SPT followed by the NT) and then the PNS. Next, only participants that were assigned to the lack-of-control condition received a partial oral debriefing (see Appendix Z for the partial oral debriefing script) in order to eliminate the influence of the lack-of-control condition on responses to the subsequent descriptive and exploratory measures. Following the partial oral debriefing, the participants in the lack-of-control condition completed the descriptive and exploratory measures. Participants that were assigned to the control condition completed the descriptive and exploratory measures immediately following completion of the dependent measures without receiving the partial oral debriefing. All participants completed the descriptive and exploratory measures in the following order: DD task, demographics, GSUQ, PGSI, ASSIST, AUDIT, BSI, BFAS, BIDR, GCI, and SPQ-B. All participants were then fully debriefed (Appendix AA) and thanked for their participation. Three researchers, including the present author, individually conducted the study, which took approximately 90 minutes per participant, over the span of approximately 7 months.

RESULTS

Data were collected from a total of 222 participants; from which 4 participants reported using cannabis within at least 12 hours prior to their participation in the study, and

therefore, their data were excluded from analyses. Thus, analyses were conducted on a total sample size of 218 participants.

A missing values analysis (MVA) was conducted in order to highlight patterns of missing values in the data set. While the MVA revealed that four variables of interest (each from the SPT) had greater than 5% missing data (DNRP = 8.7%; PI = 8.7%, ANRP = 7.8%, TA = 7.8%), Little's MCAR test of whether the data are missing completely at random was non-significant, $\chi^2(740) = 566.65, p = 1.00$, suggesting that the data are characterized as MCAR (missing completely at random). In addition, since the only variables of interest with greater than 5% missing data were derived from the SPT, a MVA was also conducted exclusively on the items from the SPT used to derive the DNRP and PI variables, $\chi^2(294) = 257.32, p = .94$, as well as on the items from the SPT used to derive the ANRP and TA variables, $\chi^2(270) = 274.08, p = .42$; which again revealed the data to be characterized as MCAR, with no items having greater than 5% missing data. As such, it was decided to conduct subsequent analyses using pairwise deletion of cases as opposed to estimating the missing data; deletion of cases is considered to be a reasonable choice when the pattern of missing data is random (Tabachnick & Fidell, 2007).

Demographic and Descriptive Information

Analyses of Variance (ANOVAs) and chi-square results comparing demographic variables across the 5 generated groups based on problem severity are presented in Table 1. As shown in the table, the sample consisted of individuals that for the most part were in their early twenties, female, single, living in an urban area, employed, Caucasian and Asian, and reported that religion ranges from somewhat important to not very important.

Table 1

Analysis of Variance (ANOVA) and Chi-Square Results Comparing Selected Demographic Variables across Group Categorization (N = 218)

Variable	At-Risk Gamblers (n = 35)	At-Risk Cannabis Users (n = 42)	Pure Controls (n = 67)	Non-Pure Controls (n = 44)	At-Risk Comorbid Participants (n = 30)	Total Sample (n = 218)	Omnibus F-Test / Chi-Square
Age, M (SD)	21.1 (4.5)	21.0 (2.9)	22.1(5.3)	20.9 (3.3)	20.7 (5.1)	21.3 (4.4)	0.9
Gender (% male)	60.0%	38.1%	17.9%	36.4%	50.0%	36.7%	20.7***
Marital status (% single)	94.3%	95.2%	85.1%	97.7%	93.3%	92.2%	--
Area of residence (% urban)	100.0%	90.5%	98.5%	93.2%	100.0%	96.2%	--
Occupation status (% employed)	77.1%	54.8%	56.7%	56.8%	63.3%	60.6%	5.3
Importance of religion ⁱ , M (SD)	2.9 (0.9)	3.2 (1.0)	2.6 (1.1)	2.8 (1.1)	2.9 (0.8)	2.8 (1.0)	2.8
Ethnicity							
Caucasian	28.6%	64.3%	44.8%	47.7%	20.0%	43.1%	
Asian	62.9%	14.3%	41.8%	31.8%	56.7%	39.9%	
Other	8.6%	21.4%	13.4%	20.5%	23.3%	17.0%	27.9***

Note. Chi-square tests were not calculated in instances where the assumptions of cell size were not met; namely, in instances where more than 20% of cells contained 5 or less members. Em dash's occupy cells in the F-test / Chi-Square column where chi-square tests were not calculated.

ⁱ N = 217.

*** $p < .001$.

While at-risk gamblers were most likely to be males, at-risk cannabis users, pure controls, and non-pure controls were most likely to be females; at-risk comorbid participants were equally likely to be males or females. In addition, at-risk gamblers and at-risk comorbid participants were most likely to be Asian whereas at-risk cannabis users, pure controls, and non-pure controls were most likely to be Caucasian.

Overall, based on PGSI scores, 51% of the sample qualified as non-problem gamblers, 19% as low-risk gamblers, 24% as moderate-risk gamblers, and 6% as problem gamblers. Based on ASSIST scores, 67% of the sample qualified as having no risk of cannabis use problems whereas 30% qualified as moderate-risk cannabis users, and 3% as high-risk cannabis users. Based on AUDIT scores, 37% of the sample qualified as problem drinkers whereas 63% qualified as non-problem drinkers.

ANOVA and chi-square results comparing gambling, cannabis use, alcohol use, other substance use, and psychological distress variables across the 5 generated groups based on problem severity are presented in Table 2. As shown in the table, the participants categorized into the at-risk gamblers group had higher PGSI scores compared to at-risk cannabis users, pure controls, and non-pure controls, but not at-risk comorbid participants. At-risk cannabis users had higher ASSIST scores compared to all of the other groups. Both at-risk cannabis users and at-risk comorbid participants had higher AUDIT scores compared to at-risk gamblers, pure controls, and non-pure controls; and at-risk gamblers had higher AUDIT scores than pure controls. Moreover, while at-risk cannabis users and at-risk comorbid participants were most likely to qualify as problem drinkers based on their AUDIT scores, at-risk gamblers, pure controls, and non-pure controls were most likely to

Table 2

Analysis of Variance (ANOVA) and Chi-Square Results Comparing Selected Gambling, Cannabis Use, Alcohol Use, Other Substance Use, and Psychological Distress Variables across Group Categorization (N = 218)

Variable	At-Risk Gamblers (n = 35)	At-Risk Cannabis Users (n = 42)	Pure Controls (n = 67)	Non-Pure Controls (n = 44)	At-Risk Comorbid Participants (n = 30)	Total Sample (n = 218)	Omnibus F-Test / Chi-Square
Gambling variables							
Gambling frequency, not including lottery ticket play ⁱ , <i>M</i> (SD)	4.0 _a (1.9)	1.0 _b (1.3)	0.6 _b (1.2)	2.8 _c (1.9)	3.4 _{a c} (1.7)	2.0 (2.1)	41.5 ^{***}
Lottery ticket play frequency ⁱ , <i>M</i> (SD)	1.7 _a (1.6)	0.7 _{b c} (0.9)	0.5 _b (0.6)	1.2 _{a c} (1.3)	2.3 _d (1.7)	1.1 (1.3)	14.8 ^{***}
Gambling expenditure ⁱⁱ , <i>M</i> (SD)	1.4 _a (0.9)	0.4 _b (0.5)	0.2 _b (0.5)	0.9 _c (0.5)	1.7 _a (1.1)	0.8 (0.9)	33.3 ^{***}
PGSI score, <i>M</i> (SD)	5.2 _a (3.5)	0.2 _{b c} (0.5)	0.0 _b (0.0)	1.0 _c (0.7)	6.0 _a (3.5)	1.9 (3.1)	86.1 ^{***}
Cannabis use variables							
Cannabis use frequency ⁱ , <i>M</i> (SD)	0.2 _a (0.4)	5.6 _b (1.5)	0.1 _a (0.2)	0.4 _a (0.6)	4.0 _c (2.2)	1.7 (2.5)	240.2 ^{***}
Cannabis use frequency ⁱⁱⁱ , <i>M</i> (SD)	0.2 _{a c} (0.6)	4.9 _b (1.3)	0.0 _c (0.0)	0.6 _a (1.0)	3.4 _d (1.5)	1.6 (2.2)	233.4 ^{***}
ASSIST score ^{iv} , <i>M</i> (SD)	0.6 _a (1.1)	16.2 _b (7.6)	0.0 _a (0.0)	0.9 _a (1.2)	13.7 _c (7.9)	5.3 (8.3)	131.0 ^{***}
Alcohol use variables							
Alcohol use frequency ⁱ , <i>M</i> (SD)	3.0 _{a c} (1.6)	4.7 _b (1.5)	2.6 _c (1.8)	3.7 _{a d} (2.0)	4.2 _{b d} (1.3)	3.5 (1.9)	12.2 ^{***}
Alcohol use frequency ^v , <i>M</i> (SD)	1.7 _{a c} (0.8)	2.4 _b (1.0)	1.4 _c (0.9)	1.9 _a (1.0)	1.9 _a (0.7)	1.8 (1.0)	8.0 ^{***}
AUDIT score, <i>M</i> (SD)	6.2 _a (4.5)	9.9 _b (5.8)	3.3 _c (3.1)	6.7 _a (4.7)	10.3 _b (4.8)	6.7 (5.2)	19.3 ^{***}
AUDIT category (% problem drinker)	37.1%	59.5%	9.0%	38.6%	63.3%	36.7%	40.8 ^{***}

Variable	At-Risk Gamblers (<i>n</i> = 35)	At-Risk Cannabis Users (<i>n</i> = 42)	Pure Controls (<i>n</i> = 67)	Non-Pure Controls (<i>n</i> = 44)	At-Risk Comorbid Participants (<i>n</i> = 30)	Total Sample (<i>n</i> = 218)	Omnibus <i>F</i> -Test / Chi-Square
Other substance use variables							
Nicotine use frequency, <i>M</i> (SD)	0.9 _a (2.2)	3.1 _b (2.8)	0.4 _a (1.4)	0.9 _a (1.7)	3.0 _b (3.1)	1.5 (2.4)	15.2 ^{***}
Other street or prescription drug use frequency, <i>M</i> (SD)	0.2 (0.5)	0.8 (1.1)	0.3 (1.3)	0.4 (1.3)	0.7 (1.4)	0.5 (1.2)	2.0
Psychological distress variable							
GSI score ^{vi} , <i>M</i> (SD)	0.8 _{a c} (0.6)	0.7 _a (0.6)	0.4 _b (0.4)	0.7 _a (0.5)	1.0 _c (0.6)	0.7 (0.6)	6.5 ^{***}

Note. Not including cells in the Total Sample column, means in the same row that do not share the same subscripts differ at $p < .05$ using Fisher's Least Significant Difference (LSD) comparison. For example, for the variable Nicotine use frequency, the subscripts _a and _b show that Nicotine use frequency for At-Risk Gamblers was significantly different than At-Risk Cannabis Users and At-Risk Comorbid Participants but not different than Pure Controls and Non-Pure Controls. AUDIT = Alcohol Use Disorders Identification Test; ASSIST = cannabis section from the Alcohol, Smoking, and Substance Involvement Screening Test; GSI = Global Severity Index; GSUQ = Gambling and Substance Use Questionnaire; PGSI = Problem Gambling Severity Index.

ⁱ Data were obtained from participant responses reported in the GSUQ. Means represent the following units: 0 = never; 1 = one to five times/year; 2 = six to eleven times/year; 3 = about once/month; 4 = two to three times/month; 5 = about once/week; 6 = two to seven times/week; 7 = more than seven times/week.

ⁱⁱ Data were obtained from participant responses reported in the GSUQ. Means represent the following units: 0 = \$0; 1 = between \$1 to \$100; 2 = between \$101 to \$300; 3 = between \$301 to \$500; 4 = more than \$500.

ⁱⁱⁱ Data were obtained from participant responses reported in the ASSIST. Means represent the following units: 0 = never; 2 = once or twice; 3 = monthly; 4 = weekly; 6 = daily or almost daily.

^{iv} *N* = 216.

^v Data were obtained from participant responses reported in the AUDIT. Means represent the following units: 0 = never; 1 = monthly or less; 2 = two to four times a month; 3 = two to three times a week; 4 = four or more times a week.

^{vi} *N* = 213.

^{***} $p < .001$.

qualify as non-problem drinkers. Both at-risk gamblers and at-risk cannabis users had higher GSI scores compared to pure controls, but not non-pure controls; and at-risk comorbid participants had higher GSI scores compared to at-risk cannabis users, pure controls, and non-pure controls, but not at-risk gamblers. Comparisons among the groups with respect to gambling, cannabis use, and alcohol use frequency variables appeared to be largely consistent with the corresponding comparisons among the groups with respect to gambling, cannabis, and alcohol use problem severity variables. Finally, while frequency of other street or prescription drug use did not significantly vary among the groups, at-risk cannabis users did report a higher frequency of nicotine use relative to at-risk gamblers, pure controls, and non-pure controls, but not at-risk comorbid participants.

Primary Analyses

A series of 2 (condition: lack-of-control, control) X 5 (group: at-risk gamblers, at-risk cannabis users, pure controls, non-pure controls, at-risk comorbid participants) between-subjects ANOVAs were conducted in order to test the main effects of condition and group on levels of illusory pattern perception. Appendix AB presents the means and standard deviations for all of the variables examined from the SPT and the NT across group categorization and experimental condition.

The first illusory pattern perception variable to be tested was DNRP from the SPT (see Table AB1 for group means and standard deviations across experimental condition).

Levene's test of equality of error variances was non-significant, $F(9, 189) = 0.57, p > .05$, indicating that homogeneity of variance could be assumed. Both the main effects for condition, $F(1, 189) = 2.03, p = .16$, and group, $F(4, 189) = 0.31, p = .87$, were found to be non-significant, suggesting that the detection of illusory or non-real patterns on the SPT

did not differ across conditions—in contrast to Whitson and Galinsky’s (2008) significant findings in their Experiment 2 (which used the SPT and employed the same experimental manipulation), $t(34) = 1.76, p = .09$, the present author’s calculated Cohen’s $d = 0.6$ —or between groups. Also, the interaction effect between condition and group was non-significant, $F(4, 189) = 0.46, p = .76$. Similarly, with respect to the ANRP variable (see Table AB2 for group means and standard deviations across experimental condition), the main effects for condition, $F(1, 191) = 2.32, p = .13$, and group, $F(4, 191) = 0.27, p = .90$, were found to be non-significant, suggesting that accuracy in identifying the 12 pictures that lacked an image on the SPT also did not differ across conditions or between groups. The interaction effect, $F(4, 191) = 0.41, p = .80$, was also non-significant.

The second illusory pattern perception variable to be tested was scores obtained on the NT (see Table AB3 for group means and standard deviations across experimental condition). Levene’s test of equality of error variances was non-significant, $F(9, 206) = 1.75, p > .05$, indicating that homogeneity of variance could be assumed. The main effect for condition was found to be significant, $F(1, 206) = 6.52, p = .01$, Cohen’s $d = 0.3$, whereby participants in the lack-of-control condition ($M = 2.66, SD = 2.58$) demonstrated greater levels of illusory pattern perception compared to participants in the control condition ($M = 1.94, SD = 2.18$). Although this condition effect was significant, the effect size was three times smaller than that obtained by Whitson and Galinsky (2008) in their Experiment 4 (which used the NT but employed a different experimental manipulation), $t(23) = 2.18, p = .04$, the present author’s calculated Cohen’s $d = 0.9$. The main effect for group, however, was found to be non-significant, $F(4, 206) = 0.97, p = .43$. Also, the interaction effect between condition and group was non-significant, $F(4, 206) = 1.21, p =$

.31. To summarize, the results above reveal partial support for the main effect of condition, but no support for the main effect of group on levels of illusory pattern perception (i.e., perceiving images or detecting patterns in pictures where in fact no image or pattern exists).

In addition, since the means (Table AB3) on the NT appeared low with an unequal distribution, it was examined whether participants merely reacted to the experimental manipulation with a response bias towards rapid and nay-say responses. To this end, a one-way ANOVA was first calculated with total reaction time (seconds) on the NT as the dependent variable, which revealed that participants in the lack-of-control condition ($M = 59.3$, $SD = 71.6$) took significantly longer to complete the NT as compared to participants in the control condition ($M = 43.4$, $SD = 38.6$), $F(1, 214) = 4.10$, $p = .04$, Cohen's $d = 0.3$. Secondly, a non-significant 2 (condition: lack-of-control, control) $\times$ 2 (response: seeing no images on the NT, seeing at least one image on the NT) chi-square analysis revealed that the percentage of participants in the lack-of-control condition that responded *no* to all of the pictures on the NT (34.3%) did not significantly differ from the percentage of participants in the control condition that responded *no* to all of the pictures on the NT (44.4%), $\chi^2(1) = 2.35$, $p = .13$. These two post-hoc findings suggest that with respect to the NT, the experimental manipulation did not produce a response bias towards rapid and nay-say responses—and the findings might lend credence to the validity of the experimental manipulation by suggesting that participants in the lack-of-control condition spent more time searching for patterns.

Differences in the DRP and PI variables from the SPT were also examined. With respect to the DRP variable (see Table AB4 for group means and standard deviations across

experimental condition), Levene's test of equality of error variances was significant, $F(9, 202) = 2.03, p < .05$, indicating that separate variance estimates for subsequent planned t -test comparisons were required because homogeneity of variance could not be assumed. However, since the main effect of group was found to be non-significant, $F(4, 202) = 0.68, p = .60$, planned t -test comparisons between the groups were not conducted. The main effect for condition was found to be significant, $F(1, 202) = 5.91, p = .02$, Cohen's $d = 0.3$, whereby participants in the lack-of-control condition ($M = 11.18, SD = 0.97$) detected more real patterns compared to participants in the control condition ($M = 10.84, SD = 1.16$). Also, the interaction effect between condition and group was non-significant, $F(4, 202) = 0.46, p = .77$. Interestingly, a one-way between-subjects ANOVA with ARP (see Table AB5 for group means and standard deviations across experimental condition) as the dependent variable revealed that participants in the lack-of-control condition were not significantly more accurate at naming the images in the 12 pictures on the SPT that contained a real image, $F(4, 204) = 0.85, p = .36$, suggesting that lack of control increased the detection of real patterns but not the accuracy of naming real patterns. The group, $F(4, 202) = 0.46, p = .77$, and interaction effects were non-significant.

With respect to the PI variable (see Table AB6 for group means and standard deviations across experimental condition), Levene's test of equality of error variances was non-significant, $F(9, 189) = 0.20, p > .05$, indicating that homogeneity of variance could be assumed. The main effect for condition was not quite significant, $F(1, 189) = 3.64, p = .06$, Cohen's $d = 0.2$, whereby participants in the lack-of-control condition ($M = 14.79, SD = 3.43$) tended to more often detect both non-real and real patterns (i.e., positive identifications) compared to participants in the control condition ($M = 13.96, SD = 3.48$).

The main effect for group was found to be non-significant, $F(4, 189) = 0.38, p = .82$, as was the interaction between condition and group, $F(4, 189) = 0.60, p = .66$. Similarly, with respect to the TA variable (see Table AB7 for group means and standard deviations across experimental condition), the main effects for condition, $F(1, 191) = 0.63, p = .43$, and group, $F(4, 191) = 1.21, p = .31$, were found to be non-significant, suggesting that accuracy in naming all of the 24 pictures in the SPT did not differ across conditions or between groups. The interaction effect, $F(4, 191) = 0.52, p = .72$, was also non-significant. Thus, the results from the ANOVAs using DRP and PI as separate dependent variables are consistent with the illusory pattern perception results reported above, whereby there appears to be partial support for a condition effect--with participants in the lack-of-control condition tending to demonstrate more detection of both non-real and real patterns compared to participants in the control condition--but not a group effect.

Finally, the main effect for condition on participants' need for structure was examined by using scores on the PNS ($M = 41.54, SD = 9.02$, suggesting that the sample mostly reported that they Slightly Agree with statements favouring a personal need for structure) as the dependent variable in a one-way between-subjects ANOVA; this main effect was found to be non-significant, $F(1, 216) = 0.14, p = .71$, in contrast to Whitson and Galinsky's (2008) significant findings in their Experiment 1 (which used the PNS and employed the same experimental manipulation), $t(27) = 2.11, p = .04$, the present author's calculated Cohen's $d = 0.8$

While the results do not support a group effect on levels of illusory pattern perception or on detection of real patterns, it should be noted that the assumption that individuals with addictive behaviour problems exhibit greater degrees of distal lack of

control in their everyday lives might be considered supported if symptoms of psychological distress are used as an indicator of distal levels of lack of control. That is, as shown in Table 2, both at-risk gamblers and at-risk cannabis users were more likely to have higher scores on the measure of psychological distress symptoms (i.e., the GSI from the BSI) compared to pure controls, but not non-pure controls; and at-risk comorbid participants had higher psychological distress symptom scores compared to at-risk cannabis users, pure controls, and non-pure controls, but not at-risk gamblers.

DISCUSSION

The purpose of the present study was to investigate whether the established link between lack of control and illusory pattern perception (Whitson & Galinsky, 2008) was exacerbated among individuals with gambling and cannabis use problems. The results in part replicated the findings of Whitson and Galinsky in that all participants in the lack-of-control condition perceived more illusory patterns than participants in the control condition in one of two illusory pattern perception tasks. Interestingly, in contrast to Whitson and Galinsky, the results also demonstrated that participants in the lack-of-control condition tended to detect more real patterns compared to participants in the control condition. This second finding suggests that lack of control seems to increase the detection of both non-real and real patterns. Moreover, analyses revealed that participants in the lack-of-control condition were not more accurate in identifying both non-real and real patterns than control participants, which suggests that the effect of lack of control is specific to the detection of patterns, and not the accuracy in identifying those patterns. In the context of gambling, these findings imply that games that induce greater levels of lack of control might lead to

increased pattern perception—albeit not accurate pattern perception—which might result in subsequent negative gambling decisions that are based on that pattern perception.

In contrast to Whitson and Galinsky (2008), an increase in the need for structure was not observed among participants in the lack-of-control condition relative to the control condition. This third finding is difficult to explicate. One possible explanation revealed through the exploratory analyses was that the need for structure scale was moderately correlated with the personality trait of conscientiousness, suggesting that the need for structure might be robust to change. It is also possible that the lack of control manipulation used in the present study was simply weaker than that in Whitson and Galinsky, which is consistent with the weaker effect size and partial condition effect observed.

The results did not reveal any differences among the five groups with respect to levels of illusory pattern perception. It was originally hypothesized that differences among the groups would be observed due to the assumption that individuals with addictive behaviour problems exhibit greater levels of lack of control in their everyday lives. The finding that the groups differed in symptoms of psychological distress lends some credence to the aforementioned assumption. Nevertheless, while no group effect was observed among the non-clinical sample used in the present study, it is possible that differences would emerge among a clinical sample with more severe problem severity. Indeed, only 6% of participants in the current sample qualified as problem gamblers and only 3% of participants qualified as high-risk cannabis users.

Several limitations from the present study are noteworthy. First, the non-rigorous recruitment method failed for a variety of reasons (see Appendix C), which resulted in a sample of participants that was not originally intended. While the resulting sample

demonstrated differences in gambling and cannabis use problem severity, the level of problem severity exhibited by the groups was not at the level desired to ideally test the hypotheses in the present study. Thus, one threat to the external validity of the findings concerns the relatively low problem severity and analogue nature of the sample. Similarly, since the 5 groups that were generated based on problem severity significantly varied with respect to gender, ethnicity, and alcohol problem severity, the extent to which these differences impacted the results is unclear.

Second, another threat to the external validity of the findings is that the main dependent variable--illusory pattern perception--is only one kind of cognitive distortion, rendering the null group effect specific to illusory pattern perception. It is quite possible that group effects would have been observed had other cognitive distortions--and in particular, gambling-related cognitive distortions--been measured during the experimental manipulation. Thus, future research ought to continue to investigate the mechanistic contribution of lack of control to gambling-related cognitive distortions in the context of a more ecologically valid experimental design.

To that end, it might be worthwhile to examine the effects of gambling-related lack of control on gambling-related cognitive distortions. For example, it might be fruitful to measure how particular kinds of gambling-related cognitive distortions are affected by games that vary in the amount of control given to participants. Based on the model of lack of control proposed in the present study, due to an already heightened level of distal lack of control, problem gamblers (relative to non-problem gamblers) should theoretically experience a greater number and intensity of gambling-related cognitive distortions in the

context of games where proximal lack of control is heightened (e.g., slot machines) relative to games where proximal lack of control is less influential (e.g., poker).

Third, one threat to the internal validity of the findings was that the intellectual functioning of the participants was not taken into account, which is problematic in light of the notion that the cognitive distortions might vary as a function of intelligence. Moreover, anecdotal accounts from participants indicated that the concept-identification task used to manipulate lack of control was difficult, which might have resulted in a weak experimental manipulation, despite efforts to ensure that participants understood the task.

Fourth, it was not established in either the present study or in Whitson and Galinsky (2008) whether the experimental manipulation actually served to induce a sense of lack of control. While the experimental manipulation was initially borrowed from the Pittman and Pittman (1979) study, which demonstrated that the concept-identification task increased feelings of depression, anxiety, and hostility among participants in a high helplessness condition relative to controls, the precise relation of the construct of lack of control to the concept-identification task remains to be explicated. Nevertheless, in light of the results investigating the NT in the present study, which found evidence that participants in the lack-of-control condition spent more time searching for patterns in the NT and did not display a nay-saying response bias, some credence is indeed provided to the notion that the experimental manipulation induced lack of control via the presentation of random performance feedback.

Finally, while symptoms of psychological distress were regarded in the present study as an indirect index of distal lack of control, a major limitation concerns the fact that distal lack of control was not explicitly measured; which is a problem given that group

differences were predicated on the assumption that individuals with more severe gambling and cannabis use problems experience greater levels of distal lack of control. The construct of distal lack of control was not measured in part because there is no gold standard to do so and in part because it is a difficult construct to confidently assess via self-report. The results of the present study are thus limited in that levels of distal lack of control were only indirectly gauged by symptoms of psychological distress, and thus, it is difficult to ascertain whether in fact group differences in distal lack of control were present between the groups. Future research ought to develop accurate ways to measure this construct in order to better assess the role of lack of control in addictions. In the context of gambling, one useful index of degree of control that has been suggested in the literature is the ratio of intended to actual expenditure on gambling (Weinstock et al., 2004).

It is hoped that the present study will point to future research directions that will lead to a better understanding of the cognitive processes that are involved in gambling behaviour. To the extent that gambling-related cognitive distortions serve as etiological risk factors in the development and maintenance of gambling pathology, further research investigating possible moderators and mediators of these distortions, such as the experience of lack of control, is warranted in order to facilitate the development of more cost-effective treatment strategies for gambling problems.

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APPENDIX A

Exploratory Hypotheses, Results, and Brief Discussion

Hypotheses

First, it was hypothesized that higher levels of both gambling-related cognitive distortions and schizotypal traits would independently predict higher levels of illusory pattern perception. Second, it was expected that higher levels of gambling frequency and problem severity, cannabis use frequency and problem severity, alcohol frequency and problem severity, delay discounting, symptoms of psychological distress, neuroticism, and self-deceptive enhancement would be related to higher levels of illusory pattern perception. Third, in light of the findings from Bagby et al. (2007), it was expected that gambling problem severity would be positively related to neuroticism and negatively related to conscientiousness. Fourth, it was expected that conscientiousness would be positively correlated with the personal need for structure. Finally, it was expected that mean response latencies (ms) on the NT would be positively correlated with levels of illusory pattern perception on the NT.

Results and Brief Discussion

A series of regression analyses were conducted in order to explore whether gambling-related cognitive distortions (as measured by the GCI) and schizotypal traits (as measured by the SPQ-B) predicted levels of illusory pattern perception. With respect to the first illusory pattern perception variable, it was found that both the GCI, $R = .16$, $R^2 = .03$, $F(1, 192) = 5.06$, $p = .03$, and the SPQ-B, $R = .16$, $R^2 = .03$, $F(1, 195) = 4.95$, $p = .03$, accounted for a significant amount of variance in DNRP on the SPT, indicating that levels of gambling-related cognitive distortions and schizotypal traits predict the detection of non-

real patterns on the SPT. Interestingly, both the GCI, $R = .15$, $R^2 = .02$, $F(1, 194) = 4.47$, $p = .04$, and the SPQ-B, $R = .16$, $R^2 = .03$, $F(1, 197) = 5.27$, $p = .02$, also accounted for a significant amount of variance in ANRP on the SPT, indicating that levels of gambling-related cognitive distortions and schizotypal traits predict decreased accuracy in the identification of non-real patterns on the SPT. However, with respect to the second illusory pattern perception variable, neither the GCI, $R = .13$, $R^2 = .02$, $F(1, 209) = 3.52$, $p = .06$, nor the SPQ-B, $R = .02$, $R^2 = .00$, $F(1, 212) = 0.05$, $p = .83$ accounted for a significant amount of variance in scores on the NT. Thus, higher levels of gambling-related cognitive distortions and schizotypal traits partially and independently predicted higher levels of illusory pattern perception (and lower levels of accuracy in non-real pattern identification on the SPT).

Additionally, it was further explored post-hoc whether gambling-related cognitive distortions and schizotypal traits predicted the detection of real patterns. Both the GCI, $R = .22$, $R^2 = .05$, $F(1, 205) = 9.98$, $p < .01$, and the SPQ-B, $R = .17$, $R^2 = .03$, $F(1, 208) = 6.12$, $p = .01$, accounted for a significant amount of variance in DRP on the SPT. Similarly, with respect to the detection of both non-real and real patterns (i.e., positive identifications), both the GCI, $R = .20$, $R^2 = .04$, $F(1, 192) = 8.12$, $p < .01$, and the SPQ-B, $R = .18$, $R^2 = .03$, $F(1, 195) = 6.80$, $p = .01$, accounted for a significant amount of variance in PI on the SPT. With regard to accuracy, neither the GCI nor the SPQ-B significantly accounted for variance in ARP; however, the GCI, $R = .167$, $R^2 = .03$, $F(1, 194) = 5.54$, $p = .02$, and the SPQ-B, $R = .16$, $R^2 = .03$, $F(1, 197) = 5.43$, $p = .02$, did significantly account for variance in TA.

It is worth highlighting that the GCI and the SPQ-B are only moderately correlated ($r = -.37, p < .001, n = 211$), which suggests that although both are measuring cognitive distortions, the nature of those distortions is not isomorphic. Nevertheless, overall, these exploratory results suggest that both gambling-related cognitive distortions and schizotypal traits partially predict not only illusory pattern perception, but perception of real patterns as well. The results also suggest that gambling-related cognitive distortions and schizotypal traits predict lower levels of accuracy in the identification of both non-real and real patterns. In light of the fact that no group effect was observed in the primary data analyses of the present study, this finding suggests that the vulnerability to gambling-related cognitive distortions and schizotypal traits is a dissociable effect from addiction problem severity on pattern perception. In other words, it suggests that irrespective of addiction problem severity, individuals that have a disposition towards gambling-related cognitive distortions and schizotypal traits are more likely to perceive both illusory and non-illusory patterns relative to individuals without this disposition, and are less likely to be accurate in the identification of those patterns. In the context of gambling, the implication of this finding is that the vulnerability to gambling-related cognitive distortions might serve as a risk factor for not only the maintenance of problem gambling, but particularly the development of problem gambling among a subtype of non-clinical gamblers. That is, in the context of gambling, having a vulnerability to gambling-related cognitive distortions might lead to the increased detection and decreased accuracy of both illusory and non-illusory pattern perception during play, which might negatively affect subsequent gambling decisions. In this vein, future research is warranted that investigates the dual role of

vulnerability to gambling-related cognitive distortions and pattern perception on gambling decisions.

There was mixed support for the remaining exploratory hypotheses. As shown in Table A1, higher levels of illusory pattern perception were not significantly related to higher levels of gambling frequency and problem severity, cannabis use frequency and problem severity, alcohol frequency and problem severity, delay discounting, symptoms of psychological distress, neuroticism, or self-deceptive enhancement. In addition, the hypothesis that gambling problem severity would be negatively related to conscientiousness did not reach statistical significance ($r = -.10, p = .15, n = 216$).

On the other hand, evidence was provided indicating that gambling problem severity was positively related to neuroticism ($r = .14, p = .04, n = 216$); that conscientiousness was positively correlated with the personal need for structure ($r = .43, p < .001, n = 216$); and that mean response latencies (ms) per trial on the NT were positively correlated with levels of illusory pattern perception on the NT ($r = .18, p < .01, n = 216$).

Table A1

Pearson Correlations between Selected Variables and Illusory Pattern Perception Variables

Variable	Illusory Pattern Perception Variables			
	NT scores		DNRP scores	
	<i>r</i>	<i>n</i>	<i>r</i>	<i>n</i>
Gambling frequency, not including lottery ticket play	.01	216	.06	199
Lottery ticket play frequency	.08	216	.01	199
PGSI score	.08	216	.09	199
Cannabis use frequency ⁱ	-.11	216	-.04	199
Cannabis use frequency ⁱⁱ	-.09	216	-.02	199
ASSIST score	-.11	216	-.03	199
Alcohol use frequency ⁱ	.04	216	.02	199
Alcohol use frequency ⁱⁱⁱ	-.03	216	-.03	199
AUDIT score	.03	214	-.04	197
AUC score	-.12	215	-.04	199
GSI score	-.05	211	.07	195
Neuroticism score	-.04	214	-.02	197
SDE score	.12	212	.06	195

Note. None of the correlation tests reached statistical significance. AUC = Area Under the Discounting Curve; AUDIT = Alcohol Use Disorders Identification Test; ASSIST = cannabis section from the Alcohol, Smoking, and Substance Involvement Screening Test; DNRP = Detection of Non-Real Patterns from the Snowy Picture Task (SPT); GSI = Global Severity Index from the Brief Symptom Inventory (BSI); GSUQ = Gambling and Substance Use Questionnaire; NT = Noise Task; PGSI = Problem Gambling Severity Index; SDE = Self-Deceptive Enhancement scale from the Balanced Inventory of Desirable Responding (BIDR).

ⁱIndicates that data were obtained from participant responses reported in the GSUQ.

ⁱⁱIndicates that data were obtained from participant responses reported in the ASSIST.

ⁱⁱⁱIndicates that data were obtained from participant responses reported in the AUDIT.

References

- Bagby, R. M., Vachon, D. D., Bumash, E. L., Toneatto, T., Quilty, L. C., & Costa, P. T. (2007). Pathological gambling and the five-factor model of personality. *Personality and Individual Differences*, 43, 873-880.

APPENDIX B

*Study Advertisements**Advertisement 1*

Study Information	
Study Name	Cognition and Pattern Perception -- Group A (see if you're eligible!)
Abstract	Complete computer tasks and fill out questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health.
Description	<p>ELIGIBILITY REQUIREMENTS: You must gamble in some form [e.g., spending money on casino slot machines, video lottery terminals (VLTs), BINGO, card or board games with family or friends (for money), gambling on the internet, sports select (e.g., Pro Line, Point Spread), sports pools, horse races, etc.] at least 4 or more times per month [NOT INCLUDING playing lottery tickets such as 649 or Super 7, instant-win or scratch tickets].</p> <p>DESCRIPTION: You will be asked to complete computer tasks that measure aspects of your cognition and perception. You will also be asked to provide demographic information as well as complete questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health. Time Required: 60 – 90 minutes. Payment: 1.5 psychology course bonus credits.</p> <p>PREPARATION: For the results of the study to be valid, it is important that you do NOT use any substances (with the exception of tobacco and medication prescribed by your Doctor), including alcohol and cannabis, at least 12 hours before you participate in the study.</p> <p>LOCATION: The study is located in Room A240, which is on the second floor of the Administration Building.</p>
Eligibility Requirements	You must gamble at least 4 or more times per month (please see the study description for more details)
Sign-Up Restrictions	<p>You must NOT have signed up or completed ANY of these studies:</p> <ul style="list-style-type: none"> • Cognition and Pattern Perception -- Group B (see if you're eligible!) • Cognition and Pattern Perception -- Group C (see if you're eligible!)
Duration	90 minutes
Preparation	do NOT use any substances at least 12 hours before you participate in the study (please see the study description for more details)
Credits	1.5 Credits
Researcher	Jonathan Stea

	Email: CognitionPerception@gmail.com
Principal Investigator	David HODGINS
Deadlines	Sign-Up: 1 hour(s) before the appointment Cancellation: 2 hour(s) before the appointment

Advertisement 2

Study Information	
Study Name	Cognition and Pattern Perception -- Group B (see if you're eligible!)
Abstract	Complete computer tasks and fill out questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health.
Description	<p>ELIGIBILITY REQUIREMENTS: You must use cannabis in some form (e.g., marijuana, hash) at least 4 or more times per week.</p> <p>DESCRIPTION: You will be asked to complete computer tasks that measure aspects of your cognition and perception. You will also be asked to provide demographic information as well as complete questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health. Time Required: 60 – 90 minutes. Payment: 1.5 psychology course bonus credits.</p> <p>PREPARATION: For the results of the study to be valid, it is important that you do NOT use any substances (with the exception of tobacco and medication prescribed by your Doctor), including alcohol and cannabis, at least 12 hours before you participate in the study.</p> <p>LOCATION: The study is located in Room A240, which is on the second floor of the Administration Building.</p>
Eligibility Requirements	You must use cannabis at least 4 or more times per week.
Sign-Up Restrictions	<p>You must NOT have signed up or completed ANY of these studies:</p> <ul style="list-style-type: none"> • Cognition and Pattern Perception -- Group A (see if you're eligible!) • Cognition and Pattern Perception -- Group C (see if you're eligible!)
Duration	90 minutes
Preparation	do NOT use any substances at least 12 hours before you participate in the study (please see the study description for more details)
Credits	1.5 Credits

Researcher	Jonathan Stea Email: CognitionPerception@gmail.com
Principal Investigator	David HODGINS
Deadlines	Sign-Up: 1 hour(s) before the appointment Cancellation: 2 hour(s) before the appointment

Advertisement 3

Study Information	
Study Name	Cognition and Pattern Perception -- Group C (see if you're eligible!)
Abstract	Complete computer tasks and fill out questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health.
Description	<p>ELIGIBILITY REQUIREMENTS: You must NOT have gambled in any form [e.g., spending money on casino slot machines, video lottery terminals (VLTs), lottery tickets such as 649 or Super 7, instant-win or scratch tickets, raffle tickets or fundraising tickets, BINGO, card or board games with family or friends (for money), gambling on the internet, sports select (e.g., Pro Line, Point Spread), sports pools, horse races, etc.] or used cannabis in any form (e.g., marijuana, hash) in the last 60 days.</p> <p>DESCRIPTION: You will be asked to complete computer tasks that measure aspects of your cognition and perception. You will also be asked to provide demographic information as well as complete questionnaires regarding cognition, perception, alcohol and drug use, gambling, personality, and mental health. Time Required: 60 – 90 minutes. Payment: 1.5 psychology course bonus credits.</p> <p>PREPARATION: For the results of the study to be valid, it is important that you do NOT use any substances (with the exception of tobacco and medication prescribed by your Doctor), including alcohol and cannabis, at least 12 hours before you participate in the study.</p> <p>LOCATION: The study is located in Room A240, which is on the second floor of the Administration Building.</p>
Eligibility Requirements	You must NOT have gambled or used cannabis in the last 60 days (please see the study description for more details)
Sign-Up Restrictions	<p>You must NOT have signed up or completed ANY of these studies:</p> <ul style="list-style-type: none"> • Cognition and Pattern Perception -- Group A (see if you're eligible!) • Cognition and Pattern Perception -- Group B (see if you're eligible!)

Duration	90 minutes
Preparation	do NOT use any substances at least 12 hours before you participate in the study (please see the study description for more details)
Credits	1.5 Credits
Researcher	Jonathan Stea Email: CognitionPerception@gmail.com
Principal Investigator	David HODGINS
Deadlines	Sign-Up: 1 hour(s) before the appointment Cancellation: 2 hour(s) before the appointment

APPENDIX C

Possible Reasons for the Failure of the Recruitment Method

First, since the eligibility requirements were ambiguously phrased such that potential participants were required to gamble or use cannabis *4 or more times* per month or per week, respectively, there was likely confusion as to whether the requirement meant 4 or more occasions within one day, whether it meant 4 separate occasions over the span of 4 days, or somewhere in between. Although any of the aforementioned scenarios might be indicative of problem severity, the specification of 4 or more times per month or per week poses a challenge to the recruitment and classification of weekly gamblers and daily cannabis users.

Second, the title of the study advertisement intended to recruit frequent cannabis users was not ethically permitted to include any reference to cannabis, which may have contributed to confusion by students surrounding their eligibility to participate in the study. As such, the title of each of the three study advertisements made no reference to either gambling or cannabis (see Appendix A). Typically on the RPS, if students are not eligible for participation in a study due to their prescreen responses, then the system filters those studies such that participants are not able to view and sign-up for participation. In the present study, however, since all psychology students were able to view all three study advertisements, some participants might have thought they were eligible to participate in the study despite the written eligibility requirements displayed on the study advertisements; indeed, this was anecdotally the case for at least one male participant that signed-up for the frequent gambling group despite reporting verbally that he had never gambled.

In an attempt to mitigate this problem, the following prescreen question from a separate study on the RPS was used starting at approximately the half-way point during the course of the study time frame to help filter participation in the frequent gambling group: “In the past 12 months have you bet money on any of the following activities: VLT's, casino slots, casino games (e.g. blackjack), poker, online games, raffles, sports select, sports pools, bingo, games of skill (e.g. pool), board games, or video games?” In addition, beginning at that time, the following reminder email to check the eligibility requirements of the study was sent as often as possible to students that signed-up for the frequent gambling and frequent cannabis use groups: “Thank you for your willingness to participate in our Cognition and Pattern Perception psychology study. This email is to remind you to PLEASE REVIEW THE ELIGIBILITY REQUIREMENTS for the study that you signed-up for to make sure that you meet the criteria. You can review the eligibility requirements on the Research Participation System (Sona), which is the place that you initially signed-up for the study. Thank you, Jonathan N. Stea.”

Third, given the limited time frame (i.e., approximately 7 months) and the structural characteristics (i.e., one participant per 90 minutes) of the study, recruitment was slow, which prolonged troubleshooting efforts. To mitigate this problem, the sign-up and cancellation date for participation was changed on the RPS from 36 hours before the study was to occur to 1 hour before the study was to occur. Even with this adjustment, however, it was often the case that participants would cancel their participation within a couple hours before the study was to occur, which made it difficult to solicit replacement participants.

Finally, a challenge to the recruitment method was circumventing the potential dishonesty of some of the student participants. Unfortunately, at the time, the present study

was only one of a few studies available on the RPS, which might have fueled the motive for some students to sign-up for the study despite not meeting the eligibility requirements in order to receive course credit.

APPENDIX D

*Instructions for the Concept-Identification Task**Screen 1*

This is a concept identification task. Please take your time and read the following instructions very carefully.

You will be presented with pairs of symbols that look like the pair at the bottom right corner of your screen. One symbol will be on the right side of the screen and one symbol will be on the left side of the screen.

Notice that each symbol contains 5 dimensions (letter, size, colour, border, underline) with 2 values for each dimension, so that there are 10 values in total:

letter (values: A or T), size (values: UPPERCASE or LOWERCASE), colour (values: BLACK or RED), border (values: CIRCLE or SQUARE), and underline (values: SOLID or DOTTED).

In each pair of symbols, the symbol on the left will be composed of 5 values that are opposite to the values of the symbol on the right. For example, look at the pair of symbols displayed at the bottom right corner of your screen. Notice that the left symbol is composed of the following values: letter 'T', LOWERCASE size, the colour RED, the SQUARE border, and the DOTTED underline; whereas the right symbol is composed of the opposite values: letter 'A', UPPERCASE size, the colour BLACK, the CIRCLE border, and the SOLID underline.

Press any key to continue...

Screen 2

Instructions (continued...)

YOUR TASK:

You will be exposed to pairs of symbols, one pair at a time. Each new pair of symbols will be composed of a slightly different arrangement of the same 10 values. Importantly, the computer has randomly chosen only ONE value that it considers correct. The ONE correct value might be displayed in the left symbol on one trial, and it might be displayed in the right symbol on another trial. You will be exposed to ten trials.

Throughout the ten trials, your job is to LEARN the ONE correct value (using trial-and-error) by indicating which side of the screen you think displays the correct value.

Use either the <left arrow key> or the <right arrow key> to tell the computer which side of the screen you think that the correct value is displayed. Each time you select a side of the screen, the computer will tell you if you are correct or incorrect, and will then present you with another pair of symbols.

For the FIRST pair of symbols, you will have to guess which side of the screen contains the correct value. From there, you should try to LEARN the correct value based on trial-and-error. For example, if you think the computer has selected the colour RED as the correct value, then you would use the left or right arrow keys to point to the side of the screen containing the colour RED. If the computer tells you that you are INCORRECT, then you should guess a different value on the next trial. Through this trial-and-error process, your job is to LEARN the ONE correct value.

In sum, it is your job to determine what the correct value is based on the feedback that the computer provides. You should learn the correct answer from the computer's feedback and choose correctly as often as possible. After the ten trials, you will be asked which value you think the computer had selected as the ONE correct value. In other words, there is only ONE correct value, and after you see all ten trials, you will be asked which one of the following values is the one that the computer selected: letter 'A', letter 'T', UPPERCASE size, LOWERCASE size, colour RED, colour BLACK, CIRCLE border, SQUARE border, SOLID underline, or DOTTED underline.

For each trial, you will have a maximum of 15 seconds to select the side of the screen that you think the correct value might be displayed. If you do not respond within 15 seconds, the computer will automatically skip to the next pair of symbols.

First, you will participate in a practice block with ten trials (just like the real task). This is to give you a chance to get used to the task.

Press any key to continue...

APPENDIX E

Example of a Concept-Identification Task Trial

APPENDIX F

Value Selection Screen during the Concept-Identification Task

Which of the following values do you think the computer selected?

- 0. the letter A
- 1. the letter T
- 2. UPPERCASE size
- 3. LOWERCASE size
- 4. the colour RED
- 5. the colour BLACK
- 6. the CIRCLE border
- 7. the SQUARE border
- 8. the SOLID underline
- 9. the DOTTED underline

Press a number key from 0 to 9

APPENDIX G

*Feedback during the Concept-Identification Task**Correct Feedback*

Correct Response!

Incorrect Feedback

Incorrect Response!

APPENDIX H

*Instructions to Complete the Next Block for Participants in the Lack-of-Control Condition
during the Concept-Identification Task*

You will now be exposed to ten more trials. This time, the computer has randomly selected a NEW correct value. Your job is the same: Learn the correct value the computer has selected based on the computer feedback (by using the left or right arrow keys).

Press any key to start...

APPENDIX I

*Additional Instruction Screen for Participants in the Control Condition during the
Concept-Identification Task*

If you are viewing this screen, it means that you have been assigned to the control group condition for this task. Therefore, you will be doing the real task **WITHOUT** receiving computer feedback about your responses. This will allow us to compare your guesses with the responses from other participants who would receive computer feedback.

Without feedback, it is impossible to learn the correct value that the computer selected. We just want you to make your best guess (based on your instinct) as to what value you think the computer has selected. Throughout the ten trials, use the left or right arrow keys to indicate which side of the screen you think might display the correct value.

Your performance on this task does not matter. We simply want your instinctive responses.

Press any key to begin...

APPENDIX J

*Instructions to Complete the Next Block for Participants in the Control Condition during
the Concept-Identification Task*

You will now be exposed to ten more trials. This time, the computer has randomly selected a NEW correct value. Your job is the same: Please make your best guess as to what value the computer has selected at the end of the ten trials. Throughout the ten trials, use the left or right arrow keys to indicate which side of the screen you think might display the new correct value. Your performance on this task does not matter. We simply want your instinctive responses.

Press any key to start...

APPENDIX K

Snowy Pictures Task

Note: Not including the two sample items, there is an image in items 1, 3, 4, 5, 6, 10, 11, 17, 19, 21, 22, and 24. The other items (2, 7, 8, 9, 12, 13, 14, 15, 16, 18, 20, and 23) were manipulated using digital media software so that no traces of the original picture remain.

It is helpful to be able to see objects quickly in spite of their being partially concealed by snow, rain, haze, darkness, or other visual obstructions.

Look at the picture below. What object do you see?

Sample Item 1:

1. _____anchor_____

By looking carefully at this sample you will see an anchor. The word anchor has been written on the line under this picture. Now try another sample. Write the name of the object on the line provided.

Sample Item 2:

2. _____

The picture shows a small boat sitting in the water. Boat, rowboat, or other similar words would be correct answers.

Some pictures in this test may have no object in them. If you believe a picture does not have an object in it then describe the picture by writing 'none'.

Your score on this test will be the number of pictures of objects that you name correctly. Work as quickly as you can without sacrificing accuracy. If some pictures are difficult, skip them and return to them later if you have time.

Do not spend too much time on any one picture.

PART 1

Write one or two words to describe each picture.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

PART 2

Write one or two words to describe each picture.

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____

22. _____

23. _____

24. _____

DO NOT GO BACK TO PART 1

APPENDIX L

*Noise Task**Instructions*

The following task involves visual perception.

For each picture, please indicate if you see an object.

If you believe that a picture has an object in it, then press the <y> key,
and if you believe that a picture does not have an object in it, then press
the <n> key.

After you respond, you will be shown the next picture.

Your score on this test will be the number of pictures that you name correctly.

Work as QUICKLY as you can without sacrificing accuracy.

Press any key to begin...

Description

Each of the 10 pictures consisted of random static in which no image existed. The pictures were presented one at a time, on a computer screen, to all participants in the same order presented below. Note that on the computer screen, the pictures were approximately 50% larger, centered, and presented on a black background.

5.

6.

7.

8.

9.

10.

APPENDIX M

Personal Need for Structure Scale

Read each of the following statements and decide how much you agree with each according to your attitudes, beliefs, and experiences. It is important for you to realize that there are no “right” or “wrong” answers to these questions. People are different, and we are interested in how you feel. Please respond according to the following 6-point scale:

1. Strongly disagree
2. Moderately disagree
3. Slightly disagree
4. Slightly agree
5. Moderately agree
6. Strongly agree

1. It upsets me to go into a situation without knowing what I can expect from it.
2. I’m not bothered by things that interrupt my daily routine.
3. I enjoy having a clear and structured mode of life.
4. I like to have a place for everything and everything in its place.
5. I find that a well-ordered life with regular hours makes my life tedious.
6. I don’t like situations that are uncertain.
7. I hate to change my plans at the last minute.
8. I hate to be with people who are unpredictable.
9. I find that a consistent routine enables me to enjoy life more.
10. I enjoy the exhilaration of being in unpredictable situations.
11. I become uncomfortable when the rules in a situation are not clear.

APPENDIX N

Demographics Questionnaire

DATE OF BIRTH: month: _____ day: _____ year: _____ **AGE:** _____

SEX: ___ male ___ female

MARITAL STATUS:

- ___ single
- ___ married (and not separated)
- ___ common law
- ___ separated/divorced
- ___ widowed

AREA OF RESIDENCE: ___urban ___ rural

EDUCATION: (*check off highest level only*)

- ___ No degree, certificate or diploma
- If so, please indicate the last grade you completed: _____*
- ___ Secondary (high) school graduation certificate or equivalent
- ___ Trades certificate or diploma
- ___ Other non-university certificate or diploma
- ___ University certificate or diploma below bachelor level
- ___ Bachelor's degree
- ___ University certificate or diploma above bachelor level
- ___ Degree in medicine, dentistry, veterinary medicine or optometry
- ___ Master's degree
- ___ Earned doctorate

OCCUPATION:

- ___ Employed full-time (30 or more hrs/week)
- ___ Employed part-time (less than 30hrs/week)
- ___ Unemployed (out of work but looking for work)
- ___ Student - employed part-time or full-time
- ___ Student - not employed
- ___ Retired
- ___ Homemaker
- ___ Other (*Specify*): _____
- Position/Job Title: _____

Approximate Net Yearly Income, To the Nearest \$1,000: \$ _____

ETHNICITY: (*check off all that apply; clarify if necessary*)

- ☐ Aboriginal (Inuit, Métis, North American Indian, etc.)
- ☐ Arab/West Asian (Armenian, Egyptian, Iranian, Lebanese, Moroccan...)
- ☐ Black (African, Haitian, Jamaican, Somali, etc.)
- ☐ Chinese
- ☐ Filipino
- ☐ Japanese
- ☐ Korean
- ☐ Latin American
- ☐ South Asian
- ☐ South East Asian
- ☐ White (Caucasian)
- ☐ Other (*specify*): _____

RELIGION:

- ☐ Not affiliated with a religious group
- ☐ Affiliated with a religious group

If you are affiliated, please specify:

- ☐ Aboriginal or First Nations spirituality
- ☐ Catholic
- ☐ Muslim
- ☐ Protestant
- ☐ Orthodox
- ☐ Jewish
- ☐ Eastern non-Christian
- ☐ Other (*Specify*): _____

How Important Is Religion In Your Life?

- ☐ Very important
- ☐ Somewhat important
- ☐ Not very important
- ☐ Not important at all

APPENDIX O

Gambling and Substance Use Questionnaire

1. How frequently do you engage in some form of gambling [*e.g., spending money on casino slot machines, video lottery terminals (VLTs), BINGO, card or board games with family or friends (for money), gambling on the internet, sports select (e.g., Pro Line, Point Spread), sports pools, horse races, etc.*] NOT INCLUDING playing lottery tickets such as 649 or Super 7, instant-win or scratch tickets (please circle one response)?
 - a) Never
 - b) 1-5 times/year
 - c) 6-11 times/year
 - d) About once/month
 - e) 2-3 times/month
 - f) About once/week
 - g) 2-7 times/week
 - h) More than 7 times/week
2. How frequently do you play lottery tickets such as 649 or Super 7, instant-win or scratch tickets (please circle one response)?
 - a) Never
 - b) 1-5 times/year
 - c) 6-11 times/year
 - d) About once/month
 - e) 2-3 times/month
 - f) About once/week
 - g) 2-7 times/week
 - h) More than 7 times/week
3. Please estimate how much money you spend on gambling per month (please circle one response).
 - a) \$0
 - b) Between \$1 to \$100
 - c) Between \$101 to \$300
 - d) Between \$301 to \$500
 - e) More than \$500
4. In the first column please tick (✓) the **MAIN** form of gambling you participated in over the last **12-months**. If you have not gambled in the last 12-months, then please do not tick (✓) any box.

In the second column, please tick (✓) all **OTHER** forms of gambling you may have also regularly gambled over the last **12-months**.

	<i>Form of Gambling</i>	<i>Main Form</i> (Please tick one)	<i>Other Forms</i> (Please tick one or more)
1 Wagering	<i>Horses</i>	☐	☐
	<i>Dogs</i>	☐	☐
	<i>Trotting/Standardbred</i>	☐	☐
	<i>Horse Racing</i>	☐	☐
2 Electronic Gaming Machines	<i>Poker-machines</i>	☐	☐
	<i>Video-draw</i>	☐	☐
	<i>Poker/Blackjack</i>	☐	☐
	<i>Keno</i>	☐	☐
	<i>Electronic Horse-racing</i>	☐	☐
	<i>Electronic Roulette</i>	☐	☐
3 Lotteries	<i>Lotto (649, Super 7, Pick 3)</i>	☐	☐
	<i>Scratch Cards</i>	☐	☐
	<i>Sports Lotto/Pool</i>	☐	☐
	<i>Other Lotteries</i>	☐	☐
4 Casino Table Games	<i>Card Games</i>	☐	☐
	<i>Roulette</i>	☐	☐
5 Internet On-Line Gambling	<i>Internet casino games</i>	☐	☐
6 Other	Please Specify: MAIN: _____ OTHER: _____		

5. How frequently do you use some form of cannabis (*e.g., marijuana, hash*) (please select one response)?

- a) Never
- b) 1-5 times/year
- c) 6-11 times/year
- d) About once/month
- e) 2-3 times/month
- f) About once/week
- g) 2-7 times/week
- h) More than 7 times/week

6. How frequently do you use alcohol (please select one response)?

- a) Never
- b) 1-5 times/year

- c) 6-11 times/year
- d) About once/month
- e) 2-3 times/month
- f) About once/week
- g) 2-7 times/week
- h) More than 7 times/week

7. How frequently do you use nicotine (e.g., tobacco, cigarettes) (please select one response)?

- a) Never
- b) 1-5 times/year
- c) 6-11 times/year
- d) About once/month
- e) 2-3 times/month
- f) About once/week
- g) 2-7 times/week
- h) More than 7 times/week

8. How frequently do you use other forms of street or prescription drugs, NOT including cannabis, alcohol, nicotine, or drugs prescribed by your doctor for a medical reason (please select one response)?

- a) Never
- b) 1-5 times/year
- c) 6-11 times/year
- d) About once/month
- e) 2-3 times/month
- f) About once/week
- g) 2-7 times/week
- h) More than 7 times/week

9. Please tick (✓) the substances that you have used at least once in the past **12-months**.

1	<i>Nicotine</i>	☐
2	<i>Alcohol</i>	☐
3	<i>Cannabis</i>	☐
	<i>(marijuana, hash, etc.)</i>	
4	<i>Psilocybin</i>	☐
	<i>(mushrooms)</i>	
5	<i>Cocaine</i>	☐
6	<i>Crack</i>	☐
7	<i>Ecstasy</i>	☐

- 8 *Crystal Meth*
- 9 *LSD*
- 10 *Heroin*
- 11 *Inhalants*
- 12 *GHB*
- 13 *Ketamine*
- 14 *Salvia*
- 15 *Prescription Drugs*

☐☐☐☐☐☐☐

Please specify:

- 16 *Other*

Please specify:

APPENDIX P

Problem Gambling Severity Index

Some of the following questions about gambling may not apply to you but please attempt to be as accurate as possible. Please circle the answer that best describes your experiences **over the past 12 months**.

1. How often have you bet more than you could really afford to lose?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
2. How often have you needed to gamble with larger amounts of money to get the same feeling of excitement?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
3. When you gambled, how often did you go back another day to try to win back the money you lost?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
4. How often have you borrowed money or sold anything to get money to gamble?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
5. How often have you felt that you might have a problem with gambling?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know

6. How often has your gambling caused you any health problems, including stress or anxiety?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
7. How often have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
8. How often has your gambling caused any financial problems for you or your household?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know
9. How often have you felt guilty about the way you gamble or what happens when you gamble?
 - a. Never
 - b. Sometimes
 - c. Most of the time
 - d. Almost always
 - e. Don't know

APPENDIX Q

Alcohol, Smoking, and Substance Involvement Screening Test, Cannabis Section

Some of the following questions about cannabis use may not apply to you but please attempt to be as accurate as possible. Please circle the answer that best describes your experiences.

1. In the past three months, how often have you used cannabis (marijuana, pot, grass, hash, etc.)?
 - a. Never
 - b. Once or twice
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
2. During the past three months, how often have you had a strong desire or urge to use cannabis (marijuana, pot, grass, hash, etc.)?
 - a. Never
 - b. Once or twice
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
3. During the past three months, how often has your use of cannabis (marijuana, pot, grass, hash, etc.) led to health, social, legal or financial problems?
 - a. Never
 - b. Once or twice
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
4. During the past three months, how often have you failed to do what was normally expected of you because of your use of cannabis (marijuana, pot, grass, hash, etc.)?
 - a. Never
 - b. Once or twice
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
5. Has a friend or relative or anyone else ever expressed concern about your use of cannabis (marijuana, pot, grass, hash, etc.)?
 - a. No, Never
 - b. Yes, in the past 3 months
 - c. Yes, but not in the past 3 months

6. Have you **ever** tried and failed to control, cut down, or stop using cannabis (marijuana, pot, grass, hash, etc.)?
- a. No, Never
 - b. Yes, in the past 3 months
 - c. Yes, but not in the past 3 months

APPENDIX R

Alcohol Use Disorders Identification Test

Some of the following questions about alcohol use may not apply to you but please attempt to be as accurate as possible. Please circle the answer that best describes your experiences.

1. How often do you have a drink containing alcohol?
 - a. Never
 - b. Monthly or less
 - c. 2-4 times a month
 - d. 2-3 times a week
 - e. 4 or more times a week
2. How many drinks containing alcohol do you have on a typical day when you are drinking?
 - a. 1 or 2
 - b. 3 or 4
 - c. 5 or 6
 - d. 7 to 9
 - e. 10 or more
3. How often do you have six or more drinks on one occasion?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
4. How often during the last year have you found that you were not able to stop drinking once you had started?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
5. How often during the last year have you failed to do what was normally expected of you because of drinking?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
7. How often during the last year have you had a feeling of guilt or remorse after drinking?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?
 - a. Never
 - b. Less than monthly
 - c. Monthly
 - d. Weekly
 - e. Daily or almost daily
9. Have you or someone else been injured because of your drinking?
 - a. No
 - b. Yes, but not in the last year
 - c. Yes, during the last year
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?
 - a. No
 - b. Yes, but not in the last year
 - c. Yes, during the last year

APPENDIX S

Brief Description of the Descriptive Measures

Demographics Questionnaire (Appendix M)

This author-compiled questionnaire was used to assess demographic characteristics of participants, including age, gender, marital status, area of residence, education, occupation, ethnicity, and religion.

Gambling and Substance Use Questionnaire (GSUQ; Appendix N)

This author-compiled questionnaire was used to obtain information regarding frequency and type of gambling and substance use behaviour.

Problem Gambling Severity Index (PGSI; Appendix O) from the Canadian Problem

Gambling Index (CPGI; Ferris, Wynne, & Single, 1999)

The CPGI was designed to capture aspects of gambling in the population that may be under-represented by other measures, such as the popular South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), which was produced in a clinical setting for diagnostic purposes. The CPGI includes the 9-item PGSI, which was used in the present study to measure gambling problem severity in the Canadian general population. The PGSI asks participants to rate how frequently statements apply to them on a 4-point Likert-type scale within the last 12-month period. Items address various aspects of gambling behaviour including extent of involvement, cognitions related to problem gambling, and environmental factors of problem gambling. Total PGSI scores can be used to categorize individuals as non-problem gamblers (0), low-risk gamblers (1 – 2), moderate-risk gamblers (3 – 7), and problem gamblers (8 – 27). Wynne (2003) reported good concurrent validity between the PGSI and the SOGS, as well as between the PGSI and criteria from the

Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994). In addition, it was found that the PGSI had a higher (but moderate) correlation with a clinical assessment interview compared to the SOGS and DSM-IV, thereby demonstrating moderate predictive validity. Finally, the PGSI has been reported to have good internal consistency and adequate test-retest reliability (Ferris & Wynne, 2001). *Alcohol, Smoking, and Substance Involvement Screening Test, Cannabis Section (ASSIST; WHO ASSIST Working Group, 2002; Appendix P)*

The 6-item cannabis section from the ASSIST was used to assess frequency of use and problems associated with cannabis. Scores between 4 and 26 are indicative of hazardous or harmful use, and patients that obtain scores in this range are considered at moderate risk of harm from their current pattern of cannabis use. Risk is increased for those with a past history of problems or dependence. Scores of 27 or higher suggest high risk of dependence and likelihood of health, social, financial, legal and relationship problems as a result of their cannabis use. The ASSIST has excellent psychometric properties (Henry-Edwards, Humeniuk, Ali, Poznyak, & Monteiro, 2003; Hides et al., 2009; Humeniuk, 2006; Humeniuk et al., 2008), and is viewed as an appropriate measure of cannabis problem severity for the current sample in light of its recent use among the Canadian general population in the Canadian Addiction Survey (Adlaf, Begin, & Sawka, 2005).

Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Appendix Q)

The AUDIT is a 10-item questionnaire that was used to assess frequency and problems associated with alcohol use. Total AUDIT scores of 8 or more are indicators of

hazardous and harmful alcohol use, as well as possible alcohol dependence. The AUDIT has favourable psychometric properties (Allen, Litten, Fertig, & Babor, 1997; Ash, 2004; Bischoff, 2004) and has been shown to be both reliable and valid for indicating harmful alcohol use among college students (Fleming, Barry, MacDonald, 1991; Kokotailo et al., 2004).

Brief Symptom Inventory (BSI; Derogatis, 1975)

The BSI was used to assess symptoms of psychological distress. The BSI includes 53 items and provides nine sub-scale scores measuring a range of psychological symptoms and somatic complaints. The average of all 53 items, termed the Global Severity Index (GSI), provides an overall measure of psychological distress. Higher scores on the GSI reflect higher overall distress. The BSI has favourable psychometric properties (Derogatis, 1993), has been widely used with college students (Broday & Mason, 1991; Cheng, Leong, & Geist, 1993; Cochran & Hale, 1985; Hayes, 1997; Watson & Sinha, 1999; Young, 1992), and has been shown to have predictive validity with a sample of university counseling centre clients (Peterson et al., 1981). In addition, norms for college students are available (Cochran & Hale, 1985).

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APPENDIX T

Big Five Aspects Scales

Here are a number of characteristics that may or may not describe you. For example, do you agree that you seldom feel blue? Please fill in the number that best indicates the extent to which you agree or disagree with each statement listed below. Be as honest as possible, but rely on your initial feeling and do not think too much about each item.

Use the following scale:

1	-----	2	-----	3	-----	4	-----	5
Strongly				Neither Agree				Strongly
Disagree				Nor Disagree				Agree

1. ____ Seldom feel blue.
2. ____ Am not interested in other people's problems.
3. ____ Carry out my plans.
4. ____ Make friends easily.
5. ____ Am quick to understand things.
6. ____ Get angry easily.
7. ____ Respect authority.
8. ____ Leave my belongings around.
9. ____ Take charge.
10. ____ Enjoy the beauty of nature.
11. ____ Am filled with doubts about things.
12. ____ Feel others' emotions.
13. ____ Waste my time.
14. ____ Am hard to get to know.
15. ____ Have difficulty understanding abstract ideas.
16. ____ Rarely get irritated.
17. ____ Believe that I am better than others.
18. ____ Like order.
19. ____ Have a strong personality.

20. ___ Believe in the importance of art.
21. ___ Feel comfortable with myself.
22. ___ Inquire about others' well-being.
23. ___ Find it difficult to get down to work.
24. ___ Keep others at a distance.
25. ___ Can handle a lot of information.
26. ___ Get upset easily.
27. ___ Hate to seem pushy.
28. ___ Keep things tidy.
29. ___ Lack the talent for influencing people.
30. ___ Love to reflect on things.
31. ___ Feel threatened easily.
32. ___ Can't be bothered with other's needs.
33. ___ Mess things up.
34. ___ Reveal little about myself.
35. ___ Like to solve complex problems.
36. ___ Keep my emotions under control.
37. ___ Take advantage of others.
38. ___ Follow a schedule.
39. ___ Know how to captivate people.
40. ___ Get deeply immersed in music.
41. ___ Rarely feel depressed.
42. ___ Sympathize with others' feelings.
43. ___ Finish what I start.
44. ___ Warm up quickly to others.
45. ___ Avoid philosophical discussions.
46. ___ Change my mood a lot.
47. ___ Avoid imposing my will on others.
48. ___ Am not bothered by messy people.

- 49. ___ Wait for others to lead the way.
- 50. ___ Do not like poetry.
- 51. ___ Worry about things.
- 52. ___ Am indifferent to the feelings of others.
- 53. ___ Don't put my mind on the task at hand.
- 54. ___ Rarely get caught up in the excitement.
- 55. ___ Avoid difficult reading material.
- 56. ___ Rarely lose my composure.
- 57. ___ Rarely put people under pressure.
- 58. ___ Want everything to be "just right."
- 59. ___ See myself as a good leader.
- 60. ___ Seldom notice the emotional aspects of paintings and pictures.
- 61. ___ Am easily discouraged.
- 62. ___ Take no time for others.
- 63. ___ Get things done quickly.
- 64. ___ Am not a very enthusiastic person.
- 65. ___ Have a rich vocabulary.
- 66. ___ Am a person whose moods go up and down easily.

- 67. ___ Insult people.
- 68. ___ Am not bothered by disorder.
- 69. ___ Can talk others into doing things.
- 70. ___ Need a creative outlet.
- 71. ___ Am not embarrassed easily.
- 72. ___ Take an interest in other people's lives.
- 73. ___ Always know what I am doing.
- 74. ___ Show my feelings when I'm happy.
- 75. ___ Think quickly.
- 76. ___ Am not easily annoyed.
- 77. ___ Seek conflict.

- 78. ____ Dislike routine.
- 79. ____ Hold back my opinions.
- 80. ____ Seldom get lost in thought.
- 81. ____ Become overwhelmed by events.
- 82. ____ Don't have a soft side.
- 83. ____ Postpone decisions.
- 84. ____ Have a lot of fun.
- 85. ____ Learn things slowly.
- 86. ____ Get easily agitated.
- 87. ____ Love a good fight.
- 88. ____ See that rules are observed.
- 89. ____ Am the first to act.
- 90. ____ Seldom daydream.
- 91. ____ Am afraid of many things.
- 92. ____ Like to do things for others.
- 93. ____ Am easily distracted.
- 94. ____ Laugh a lot.
- 95. ____ Formulate ideas clearly.
- 96. ____ Can be stirred up easily.
- 97. ____ Am out for my own personal gain.
- 98. ____ Want every detail taken care of.
- 99. ____ Do not have an assertive personality.
- 100. ____ See beauty in things that others might not notice.

APPENDIX U

Gambling Cognitions Inventory

A number of statements will follow about gambling. Please indicate how much you agree that the statement describes you using the following scale:

1 = strongly AGREE

2 = somewhat agree

3 = somewhat disagree

4 = strongly DISAGREE

1. _____ After losing, people should go back to win back the money they lost
2. _____ I am certain that my time for a big win is soon
3. _____ Although I am upset when I lose, I use it as a learning opportunity to improve my gambling
4. _____ I am a very skilled gambler
5. _____ I can sense when I am going to win
6. _____ I am surprised at how much money I seem to have spent gambling
7. _____ I am very confident about my gambling ability
8. _____ I can analyze my wins to give me strategies to make me a better gambler
9. _____ I lose because the probability of winning is extremely low
10. _____ After losing, I know I can win back the money I lost
11. _____ I can stay ahead or keep even by winning back money I have lost
12. _____ I can tell when I am lucky or I am having a lucky day, and that is a good day to gamble
13. _____ When I gamble, I know my chances of winning are extremely low
14. _____ It is good to look for special signs that might help a person win
15. _____ I lose because I am having a bad or unlucky day
16. _____ I need to keep a positive attitude to help me win at gambling
17. _____ Repeating certain phrases or thoughts to myself will give me good luck
18. _____ People should take advantage of times when they have good luck, and gamble more
19. _____ I tell myself losing is my fault
20. _____ I try not to dwell on my losses and focus on my wins
21. _____ I try to associate with people who win at gambling, who I think are lucky
22. _____ I try to figure out why I lost
23. _____ A winning attitude will improve my chances in gambling
24. _____ If I use special rituals, I can avoid bad luck
25. _____ I will get better at gambling with practice
26. _____ If I don't have good connection with the slot machine or VLT, I'm more likely to lose
27. _____ If I forget a certain special item at home, I wouldn't be as lucky while gambling
28. _____ If I have negative thoughts, it contributes to my bad luck and losses
29. _____ The more I lose, the closer I am to winning

- 30. _____ If you are having a losing streak, you should keep gambling
- 31. _____ In roulette, a good strategy is to bet on numbers (or suits or colours) that have not come up recently, as they are due to win
- 32. _____ Staying at the same machine increases my chances of winning
- 33. _____ The more skilled at gambling I become, the more money I expect to win
- 34. _____ There are certain strategies that can help people win on a slot machine
- 35. _____ There is no reason for winning; it is completely random
- 36. _____ When I look back at my gambling, I am surprised by the number of times I lost
- 37. _____ When I win at gambling, I know that it is just a fluke
- 38. _____ You have a better chance of becoming rich by gambling than by working
- 39. _____ You must work hard at gambling to be able to do well
- 40. _____ In a lottery, all numbers have the same chance of winning

APPENDIX V

Schizotypal Personality Questionnaire, Brief Version

Please answer each item by indicating **Y (Yes)** or **N (No)**. Answer **all** items even if unsure of your answer. When you have finished, check over each one to make sure you have answer them all.

1. _____ People sometimes find me aloof and distant.
2. _____ Have you ever had the sense that some person or force is around you, even though you cannot see anyone?
3. _____ People sometimes comment on my unusual mannerisms and habits.
4. _____ Are you sometimes sure that other people can tell what you are thinking?
5. _____ Have you ever noticed a common event or object that seemed to be a special sign for you?
6. _____ Some people think that I am a very bizarre person.
7. _____ I feel I have to be on my guard even with friends.
8. _____ Some people find me a bit vague and elusive during a conversation.
9. _____ Do you often pick up hidden threats or put-downs from what people say or do?
10. _____ When shopping do you get the feeling that other people are taking notice of you?
11. _____ I feel very uncomfortable in social situations involving unfamiliar people.
12. _____ Have you had experiences with astrology, seeing the future, UFOs, ESP or a sixth sense?
13. _____ I sometimes use words in unusual ways.
14. _____ Have you found that it is best not to let other people know too much about you?
15. _____ I tend to keep in the background on social occasions.
16. _____ Do you ever suddenly feel distracted by distant sounds that you are not normally aware of?
17. _____ Do you often have to keep an eye out to stop people from taking advantage of you?
18. _____ Do you feel that you are unable to get “close” to people?
19. _____ I am an odd, unusual person.
20. _____ I find it hard to communicate clearly what I want to say to people.
21. _____ I feel very uneasy talking to people I do not know well.
22. _____ I tend to keep my feelings to myself.

APPENDIX W

*Brief Description of the Exploratory Measures**Delay Discounting (DD; Holt, Green, & Myerson, 2003; Shead, 2004)*

A computerized DD task was used to obtain a measure of delay discounting, which is considered one way to measure impulsivity; whereby delay discounting refers to the tendency for delayed rewards to be considered worth less compared to the value of immediate rewards (Ainslie, 1975; Bickel & Marsch, 2001). The computerized DD task instructed participants to choose between a reward that was available immediately (i.e., an immediate reward) or a reward that was delayed by a specified period of time (i.e., a delayed reward). For example, one question might ask: Which option do you prefer? (a) \$200 now, or (b) \$1000 in 30 days? Participants were asked to indicate which of the two alternatives they preferred by pressing *a* or *b* on the keyboard. The delayed reward was always \$1000 and was available after one of seven delays (1, 7, 30, 90, 180, 365, or 730 days). At each of the seven delays, six questions were presented sequentially on the computer screen. Each block of six questions required participants to make a choice between an immediate reward and \$1000 at a fixed delay that increased across blocks. That is, the first block of questions contained choices between an immediate reward and \$1000 at a delay of 1 day, the second block of questions contained choices between an immediate reward and \$1000 at 7 days, and so forth. The amount of the immediate reward was adjusted across questions within each block. That is, after the first question was answered, the amount of the immediate reward was adjusted based on each participants' response to the previous question. The size of this adjustment was decreased with successive choices in order to rapidly converge on the individual's indifference point at each delay. The first

question in each block asked the participant to make a choice between the delayed reward (\$1000) and an immediate reward whose amount was half that of the delayed reward (\$500). If a participant chose the immediate reward, then the amount of the immediate reward decreased on the next choice; if a participant chose the delayed reward, then the amount of the immediate reward increased on the next choice. Each adjustment was half the difference between the immediate and delayed rewards from the previous question. Thus, the second question in each block contained an immediate reward of \$750 or \$250, depending on the participant's response to the first question. That is, half the difference between an immediate reward of \$500 and a delayed reward of \$1000 is \$250. So if a participant chose \$1000 in 30 days over \$500 immediately on the first question, the second question asked the participant to choose between \$1000 in 30 days and \$750 immediately ($\$500 + \$250 = \$750$). Alternatively, if the participant chose \$500 immediately over \$1000 in 30 days, the second question asked the participant to choose between \$1000 in 30 days and \$250 immediately ($\$500 - \$250 = \$250$). For subsequent questions, the adjustment was half the previous adjustment. For example, on the second question, if the participant chose \$1000 in 30 days over \$250 immediately, then the next question asked the participant to choose between \$1000 in 30 days and \$375 immediately (i.e., $\$250/2 = \$125 + \$250 = \375). This procedure was repeated until the participant answered all six questions in the block for the given delay. The immediate amount that would have been presented on the seventh trial, had there been one, was used as an estimate for that participant's indifference point for the given delay. Since there are seven delays, each with a block of six questions, seven indifference points were obtained for each participant. These points indicate the subjective value of the delayed reward to the participant. In other words, it indicates how

much the delayed reward is presently worth to the participant (e.g., the subjective value of \$1000 in 30 days).

Degree of discounting was established by calculating the area under the discounting curve (AUC), which is thought to be an appropriate measure of discounting that obviates several interpretative and statistical difficulties that are presented by using curve-fitting parameters (Myerson, Green, & Warusawitharana, 2001). Although the ecological validity for the DD task employed in the present study was threatened by not allocating actual monetary rewards to participants, one study employing a modified version of this task using different values and hypothetical rewards found good descriptions of discounting among gambling and non-gambling undergraduate students (Holt et al., 2003).

Big Five Aspects Scales (BFAS; DeYoung, Quilty, & Peterson, 2007; Appendix S)

The BFAS is a 100-item measure, which was used to capture ten aspects of the Big Five domain personality traits of the five-factor model (FFM)--Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness/Intellect (Costa & McCrae, 1992; Digman, 1990; Goldberg, 1993). In addition to providing scores for each of the five personality factors, the BFAS provides scores for two distinct aspects of each factor, which were empirically derived: Assertiveness and Enthusiasm aspects for Extraversion; Politeness and Compassion aspects for Agreeableness; Industriousness and Orderliness aspects for Conscientiousness; Volatility and Withdrawal aspects for Neuroticism; and Openness and Intellect aspects for Openness/Intellect. The BFAS has been validated against standard Big Five instruments such as the Big Five Inventory (BFI; John & Srivastava, 1999) and the NEO Personality Inventory Revised (NEO PI-R; Costa & McCrae, 1992); has been shown to demonstrate good internal and test-retest reliability

(DeYoung, et al., 2007); and BFAS has been used with a sample of undergraduate students (Hirsh & Peterson, 2009).

The Balanced Inventory of Desirable Responding, Version 6 (BIDR; Paulhus, 1988, 1991)

The sixth version of the BIDR was used to obtain a measure of self-deception and impression management. The BIDR consists of two subscales of 20 items each: Self-Deceptive Enhancement (SDE), which is thought to capture an unconscious bias toward positive self-portrayal, and Impression Management (IM), which is thought to reflect a conscious bias toward positive self-portrayal. The BIDR has favourable psychometric properties (Paulhus, 1991), has been widely used with student samples (Paulhus & Reid, 1991; Meston, Heiman, Trapnell, & Paulhus, 1998; Stober, Dette, & Musch, 2002) and has been shown to have good internal, external, and concurrent validity among undergraduate students and forensic clients (Lanyon & Carle, 2007).

The Gambling Cognitions Inventory (GCI; Holub, 2003; Appendix T)

The GCI was used to assess gambling-related cognitive distortions. The GCI is a 40-item self-report measure of four categories of cognitive distortion: Probability Errors, Magical Thinking/Luck, Information Processing, and Illusion of Control/Skill. A total score of 40 is indicative of the highest degree of cognitive distortion while a total score of 160 is indicative of the lowest degree of cognitive distortion. The GCI was developed and validated using a university sample. It has been shown to have acceptable internal consistency with some preliminary support found for convergent and criterion-related validity using a sample of problem and pathological gamblers (Holub, 2003).

The Schizotypal Personality Questionnaire, Brief Version (SPQ-B; Raine & Benishay, 1995; Appendix U)

The SPQ-B is a 22-item measure that was used to assess schizotypal traits. The measure yields a total score as well as scores for three factors or subscales: Cognitive-Perceptual, Interpersonal, and Disorganized. The SPQ-B has demonstrated favourable psychometric properties (Raine & Benishay, 1995), produces essentially the same three-factor structure as is obtained from subscale analysis of the full-length SPQ (Axelrod, Grilo, Sanislow, & McGlashan, 2001), and norms exist for undergraduate students (Raine & Benishay, 1995). With respect to the present study, it is noteworthy that cannabis users have been found to have higher scores on the full-length SPQ than past users and controls (Skosnik, Spatz-Glenn, & Park, 2001).

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APPENDIX X

Reminder Email to Not Use Any Substances 12 Hours Prior to Participation

Hello, thank you for your willingness to participate in our Cognition and Pattern Perception psychology study. This is a reminder that for the results of the study to be valid, it is important that you do NOT use any substances (with the exception of tobacco and medication prescribed by your Doctor), including alcohol and cannabis, at least 12 hours before you participate in the study. The study is located in Room A240, which is on the second floor of the Administration Building. Thank you for your cooperation.

--Jonathan N. Stea

APPENDIX Z

Partial Oral Debriefing Script

Before we go on, we want to tell you some information about the tasks that you have completed so far. You were randomly assigned to an experimental condition where you completed a concept-identification task (which is the first task that you completed). This task was designed to give you random feedback so that you would not be able to learn the value that the computer had chosen. So 50% of the time, the computer told you that you were correct, and 50% of the time, the computer told you that you were incorrect. The purpose of this was to make you feel that you did not have control over the task, and to observe how this would affect your perception of the pictures we showed you. We hypothesized that you would identify more objects in the pictures as compared to people in the control condition who had to complete a concept-identification task without receiving computer feedback. Again, there were no right or wrong answers in any of the tasks that you completed, and we thank you for your strong effort and your participation in our study. We kindly ask that you keep the information about this study confidential. It is important that future potential participants do not know about the study because knowledge about the study could contaminate the results.

APPENDIX AA

Debriefing Form

Research Project Title: The Relationship Between Lack of Control and Illusory Pattern Perception among Frequent Gamblers and Frequent Cannabis Users

Investigators: Jonathan N. Stea, B.Sc. (Hons.), M.Sc. Clinical Psychology Student, Department of Psychology, University of Calgary, and Mike Lambert, Department of Psychology, University of Calgary, and David C. Hodgins, Ph.D., Professor, Department of Psychology, University of Calgary.

Thank you for participating in this study about cognition and perception with respect to gambling and cannabis use. This research constitutes the M.Sc. thesis of Jonathan N. Stea, and the undergraduate Honour's thesis of Mike Lambert. Your contribution to this research is greatly appreciated.

You were randomly assigned to either an experimental condition or a control condition where you completed a concept-identification task (this is the first task that you completed). This task was designed to either give you random feedback so that you would not be able to learn the value that the computer had chosen (i.e., lack-of-control condition), or no feedback whatsoever so that feelings of lack of control would not occur (i.e., control condition). The purpose of the lack-of-control condition was to induce the feeling of having no control over the concept-identification task, and to observe how this would affect perception of the pictures we showed you. We hypothesized that participants in the lack-of-control condition would identify more objects in the pictures as compared to people in the control condition, and that this effect would be exacerbated among frequent gamblers and frequent cannabis users. There were no right or wrong answers in any of the tasks that you completed.

Research has demonstrated that cognitive distortions are prevalent among frequent gamblers (Toneatto, 1999) and frequent cannabis users (Skosnik, Spatz-Glenn, & Park, 2001). Lack of control has been found to increase cognitive distortions (Whitson & Galinsky, 2008). In light of the notion that addicted individuals experience a greater degree of lack of control in their lives, this study hypothesizes that frequent gamblers and frequent cannabis users will exhibit greater degrees of cognitive distortion both at baseline and in the experimental condition relative to control participants.

Obtaining the expected results would suggest that increasing control in the lives of addicted individuals will decrease their vulnerability to cognitive distortions. These expected results hold important implications for the treatment of problem gamblers because cognitive distortions are thought to drive problematic gambling behaviour (Xian et al., 2008). The results would suggest that increasing control among problem gamblers might reduce their cognitive distortions, which in turn, might reduce their problematic gambling behaviour. Future studies could investigate the relationship between cognitive distortions and lack of control both among problem and non-problem gamblers as well as in the context of gambling. In addition, cannabis use is common among problem gamblers

(Shaffer, Hall, & Vander Bilt, 1999), and future research could test these variables among individuals who display both problematic gambling and cannabis use.

We kindly ask that you keep the information about this study confidential. It is important that future potential participants do not know about the study because knowledge about the study could contaminate the results.

Thank you once again for your participation. If you would like to learn more about the literature surrounding this study, there are some relevant references listed below. If you are interested in the results of this study you may contact Jonathan N. Stea (210-9500; jnstea@ucalgary.ca) who will arrange to send you information when the study is complete. Please also contact him if you should have any questions or concerns regarding this research. Questions and interest are welcomed, and any concerns you might have are important to the researchers.

If you have any questions or issues concerning this project that are not related to the specific aspects of the research, or if you have any concerns about the way you've been treated as a participant, you may also contact Bonnie Scherrer, Ethics Resource Officer, Research Services Office, University of Calgary at (403) 220-3782; email: b.scherrer@ucalgary.ca.

Finally, participating in this study may have triggered concerns that you may have an addictions, mental health, or gambling problem. If you think you may have any of these problems there is help available. Please call the following free-of-charge help-lines: Problem gambling helpline: 1-800-665-9676, AADAC: 1-866-322-2322 (Alberta Only), 1-866-33AADAC (Help Line), and the Distress Centre Calgary: 403-266-1605. Additionally, if for any reason you have experienced any distress as a result of your participation in this study, I would like to advise you that the university offers a confidential counselling service to all current students. Students may receive three sessions free per academic year. The Counselling Centre is located in the MacEwan Student Centre – Room 375 and will accept either walk-in appointments or appointments made by telephone (220-5893).

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APPENDIX AB

*Means and Standard Deviations for the Variables Examined from the SPT and the NT
across Group Categorization and Experimental Condition*

Table AB1

*Group Means and Standard Deviations across Experimental Condition for the DNRP
Variable from the SPT*

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	3.2 (2.4)	17	3.1 (3.0)	16	3.2 (2.7)	33
At-Risk Cannabis Users	3.6 (2.9)	17	2.5 (2.2)	20	3.0 (2.6)	37
Pure Controls	3.5 (2.8)	29	3.4 (3.2)	33	3.5 (3.0)	62
Non-Pure Controls	3.6 (3.1)	21	3.4 (2.3)	18	3.5 (2.7)	39
At-Risk Comorbid Participants	4.5 (3.2)	12	3.1 (2.8)	16	3.7 (3.0)	28
Total	3.6 (2.8)	96	3.1 (2.8)	103	3.4 (2.8)	199

Note: Means represent the total number of images detected among the 12 pictures in the SPT that lacked an image.

Table AB2

Group Means and Standard Deviations across Experimental Condition for the ANRP Variable from the SPT

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	8.7 (2.5)	17	8.9 (3.0)	16	8.8 (2.7)	33
At-Risk Cannabis Users	8.2 (3.0)	19	9.2 (2.5)	20	8.7 (2.7)	39
Pure Controls	8.5 (2.8)	29	8.5 (3.3)	33	8.5 (3.0)	62
Non-Pure Controls	8.0 (3.6)	21	8.6 (2.3)	18	8.3 (3.0)	39
At-Risk Comorbid Participants	7.3 (3.3)	12	8.9 (2.8)	16	8.2 (3.1)	28
Total	8.2 (3.0)	98	8.8 (2.8)	103	8.5 (2.9)	201

Note: Means represent the total number of pictures accurately identified as lacking an image (i.e., by using the descriptor *none*) among the 12 pictures in the SPT that indeed lacked an image.

Table AB3

Group Means and Standard Deviations across Experimental Condition for Total Images Identified among the 10 Pictures in the NT

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	3.7 (2.8)	19	1.6 (2.0)	16	2.7 (2.7)	35
At-Risk Cannabis Users	1.7 (2.2)	22	1.7 (1.9)	20	1.7 (2.0)	42
Pure Controls	2.6 (2.8)	32	2.2 (2.5)	34	2.4 (2.6)	66
Non-Pure Controls	2.5 (2.3)	23	2.0 (2.3)	21	2.3 (2.3)	44
At-Risk Comorbid Participants	3.3 (2.3)	12	1.9 (2.0)	17	2.5 (2.2)	29
Total	2.7 (2.6)	108	1.9 (2.2)	108	2.3 (2.4)	216

Table AB4

*Group Means and Standard Deviations across Experimental Condition for the DRP
Variable from the SPT*

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	11.1 (1.0)	19	11.0 (0.8)	16	11.0 (0.9)	35
At-Risk Cannabis Users	11.1 (1.1)	20	10.6 (1.3)	20	10.9 (1.2)	40
Pure Controls	11.1 (1.1)	31	10.9 (1.1)	34	11.0 (1.1)	65
Non-Pure Controls	11.2 (0.9)	22	10.8 (1.4)	20	11.0 (1.1)	42
At-Risk Comorbid Participants	11.6 (0.7)	13	10.9 (1.2)	17	11.2 (1.1)	30
Total	11.2 (1.0)	105	10.8 (1.2)	107	11.0 (1.1)	212

Note: Means represent the total number of images detected among the 12 pictures in the SPT that contained a real image.

Table AB5

Group Means and Standard Deviations across Experimental Condition for the ARP Variable from the SPT

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	7.5 (2.0)	19	6.8 (0.9)	16	7.2 (1.6)	35
At-Risk Cannabis Users	7.7 (1.4)	21	8.4 (1.4)	20	8.1 (1.4)	41
Pure Controls	7.5 (2.0)	32	7.6 (1.6)	34	7.6 (1.8)	66
Non-Pure Controls	7.7 (1.7)	22	7.2 (2.1)	20	7.5 (1.9)	42
At-Risk Comorbid Participants	7.4 (2.3)	13	6.6 (2.0)	17	6.9 (2.2)	30
Total	7.6 (1.8)	107	7.4 (1.7)	107	7.5 (1.8)	214

Note: Means represent the total number of pictures that were accurately named (i.e., using one or two word descriptors) among the 12 pictures in the SPT that contained a real image.

Table AB6

Group Means and Standard Deviations across Experimental Condition for the PI Variable from the SPT

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	14.3 (3.1)	17	14.1 (3.6)	16	14.2 (3.3)	33
At-Risk Cannabis Users	14.8 (3.5)	17	13.1 (3.2)	20	13.9 (3.4)	37
Pure Controls	14.5 (3.6)	29	14.3 (3.7)	33	14.4 (3.7)	62
Non-Pure Controls	14.8 (3.5)	21	14.1 (3.6)	18	14.5 (3.4)	39
At-Risk Comorbid Participants	16.1 (3.6)	12	13.9 (3.6)	16	14.9 (3.7)	28
Total	14.8 (3.4)	96	14.0 (3.5)	103	14.4 (3.5)	199

Note: Means represent the total number of images detected among all 24 pictures in the SPT.

Table AB7

Group Means and Standard Deviations across Experimental Condition for the TA Variable from the SPT

Group Categorization	Lack-of-Control Condition		Control Condition		Total	
	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>	<i>M</i> (SD)	<i>n</i>
At-Risk Gamblers	16.2 (4.0)	17	15.7 (3.5)	16	16.0 (3.7)	33
At-Risk Cannabis Users	16.1 (3.0)	19	17.6 (2.8)	20	16.8 (3.0)	39
Pure Controls	16.1 (2.8)	29	16.2 (4.1)	33	16.1 (3.5)	62
Non-Pure Controls	15.7 (4.4)	21	15.6 (3.2)	18	15.6 (3.8)	39
At-Risk Comorbid Participants	14.4 (4.2)	12	15.5 (3.1)	16	15.0 (3.6)	28
Total	15.8 (3.6)	98	16.2 (3.5)	103	16.0 (3.5)	201

Note: Means represent the total number of pictures that were accurately named (i.e., as either having no image in the case of pictures that lacked an image, or using accurate descriptors in the case of pictures that contained a real image) among all 24 pictures in the SPT.