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Caffeine's influence on gambling behavior and other types of impulsivity

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HIGHLIGHTS

- Little is known about the effects of caffeine in young adults who already display impulsive behaviors.
- Higher caffeine intake was significantly associated with more nicotine consumption and more impulsivity on a gambling task.
- Higher caffeine use was associated with irrational choices on the Cambridge Gamble Task.

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ABSTRACT

Background: Young adulthood is a developmental period frequently associated with occurrence of impulsive behaviors including gambling. It is estimated that 73% of children and 87% of adults in the United States regularly use caffeine. Questions remain, however, concerning the role of caffeine in the development and maintenance of impulsive behaviors such as gambling.

Methods: Sixty-one young adults with at least some degree of disordered gambling were recruited from two Mid-Western university communities in the United States using media advertisements. Caffeine intake over the preceding month was quantified using the Caffeine Use Questionnaire. Clinician rating scales, questionnaires, and cognitive tests germane to impulsivity were completed. Relationships between caffeine intake and demographic, gambling symptom, and neurocognitive measures were evaluated using the statistical technique of partial least squares (PLS).

Results: Average weekly caffeine intake in the gamblers was 1218.5 mg (a figure higher than previously reported in the general population). PLS yielded an optimal model with one latent factor, which explained 14.8% of variation in demographic/clinical/cognitive measures and 32.3% of variation in caffeine intake. In this model, higher caffeine intake was significantly associated with earlier age at first gambling, higher personality-related impulsiveness, more nicotine consumption, older age, and more impulsive decision-making.

Conclusions: These data suggest a particularly strong relationship between caffeine intake, earlier age of first gambling, and certain types of impulsivity in gamblers. Providing education about healthy caffeine use may be especially valuable in gamblers. Future work should explore whether the relationship between caffeine use and gambling is due to a common predisposing factor (impulsive tendencies) or, rather, constitutes a form of self-medication in gamblers (or a means of sustaining gambling habits for longer).

1. Introduction

Young adulthood is a developmental period frequently associated with occurrence of impulsive behaviors (Casey, 2015; Stone, Becker, Huber, & Catalano, 2012). Peer group influences, genetics, brain development, and life transitions have all been studied as elements contributing to the elevated rates of impulsive behaviors in this age group (Chambers & Potenza, 2003; Quinn, Stappenbeck, & Fromme, 2011). It is estimated that 73% of children and 87% of adults in the United States regularly use caffeine (Branum, Rossen, & Schoendorf, 2014; Frary, Johnson, & Wang, 2005). Caffeine has been reported, in some studies, to improve mood, attention, wakefulness, and energy (Malinauskas, Aeby, Overton, Carpenter-Aeby, & Barber-Heidal, 2007; Stewart, Karp, Pihl, & Peterson, 1997). In out clinical experience, many people who gamble report using caffeine to increase their attention and ability to stay awake and continue gambling. Although largely considered

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innocuous, caffeine's effects on the development and maintenance of impulsive behaviors such as gambling remain unstudied.

The data regarding caffeine's role in impulsivity are largely mixed, and much of the conflict results from understanding the role of age, gender, low versus high dose of caffeine, and chronic versus acute use of caffeine. Interestingly, clinical trial data suggest that caffeine has some efficacy in the treatment of attention-deficit hyperactivity disorder (ADHD) (Ioannidis, Chamberlain, & Müller, 2014). Having said that, studies of adolescents or young adults have generally found that caffeinated beverages are positively associated with risk-taking, impulsivity, and sensation-seeking (Arria et al., 2011; Jones & Lejuez, 2005; Kponee, Siegel, & Jernigan, 2014; Temple, Ziegler, Graczyk, & Crandall, 2017). Other studies, however, suggest that caffeine does not appear to alter inhibition of behaviors (measured with the stop-signal task; Tieges, Snel, Kok, & Richard, 2009) or decision-making (Killgore, Grugle, & Balkin, 2009). The conflicting findings from these studies may have multiple, non-mutually exclusive explanations such as when caffeine is ingested, how much caffeine the person is generally ingesting, the task used to examine the particular cognitive issue, the individual biology/genetics of the participant who is being studied, and the source of caffeine (Smith, 2002). Self-regulation of caffeine intake is one possible explanation for these possible seemingly contradictory findings. Research demonstrates that individuals are capable of self-regulating caffeine intake to achieve maximum benefit with minimal negative effects (Smith, 2002).

The aforementioned studies did not account for psychiatric disorders, which have been commonly associated with significant individual differences in cognition (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lönnqvist, 2008; Krabbendam, Arts, van Os, & Aleman, 2005). Considering these limitations of the extant literature, more information is needed to discern whether caffeine use has a significant effect on cognition in young adults who already display impulsive behaviors as evidenced by problem gambling behavior. Thus, the present exploratory study examined clinical characteristics and multiple facets of cognition in young adult problem gamblers. Based on the extant literature, we hypothesized that higher caffeine use would be associated with greater cognitive impulsivity and more severe symptoms of gambling behavior.

2. Materials and methods

Sixty-one participants were recruited from the surrounding communities near two large Midwestern universities for a study on impulsive behavior in young adults. Inclusion criteria were age 18–29 years, being non-treatment seeking, and having at least some degree of problem gambling symptoms as defined by endorsing at least two symptoms (see later for assessment details). Subjects were excluded if they were unable to give informed consent or were unable understand/undertake the study procedures. All study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the University of Chicago approved the study and the consent statement. Participants were compensated with a $50 gift card for a local department store.

2.1. Assessments

Participants completed standard diagnostic interviews, basic demographic information, self-report impulsivity inventories, and a computerized cognitive battery focusing on impulsivity.

The Caffeine Use Questionnaire (CUQ; Modi et al., 2010) was used to examine amount of caffeine use in each participant, considered over the previous month. The CUQ is a reliable questionnaire that presents a list of nine categories of commonly consumed sources of caffeine. Participants indicate how often they use one serving (e.g. one can, one cup) of each source of caffeine by checking one of the following; never, 1–3 per month, 1 per week, 2–4 per week, 5–6 per week, 1 per day, 2–3 per day, 4–5 per day, 6 or more per day. The CUQ also provided the approximated caffeine content of each category of caffeine source in order to obtain the estimated amount of caffeine use per week, in milligrams.

Gambling symptoms during the past 12 months were evaluated using the Structured Clinical Interview for Gambling Disorder (SCI-GD), a nine-item instrument covering the DSM-5 criteria (Grant, Steinberg, Kim, Rounsaville, & Potenza, 2004; modified to reflect DSM-5). Endorsement of at least two of the nine symptoms was a pre-requisite for study inclusion. Gambling symptom severity was evaluated using the Yale Brown Obsessive Compulsive Scale Modified for Pathological Gambling (PG-YBOCS) (Pallanti, DeCaria, Grant, Urpe, & Hollander, 2005).

Psychiatric morbidity was assessed using the Mini International Neuropsychiatric Inventory (MINI) (Sheehan et al., 1998) and the Minnesota Impulsive Disorders Interview (MIDI) (Grant, 2008) by trained raters.

Neurocognitive variables were assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB) system. The following assessments were included in this analysis: Intra-Extra Dimensional Set Shift Task (IED), Stop Signal Task (SST), and the Cambridge Gambling Task (CGT). These tasks were chosen in accordance with previous findings in subjects with gambling, these domains often being impaired in patients (Goudriaan, Yücel, & van Holst, 2014; Grant, Odlaug, & Chamberlain, 2016).

2.1.1. Intra-Extra Dimensional Set Shift Task (IED)

The IED is a task examining rule acquisition and reversal learning, and is a computerized version of the Wisconsin Card Sorting task. Participants are tasked with learning an underlying rule established by the computer. Once the rule is learned, the rule will be switched and the participant must re-learn the new rule, adapting to computer feedback (Owen, Roberts, Polkey, Sahakian, & Robbins, 1991).

2.1.2. Stop Signal Task (SST)

The SST tests the participant's ability to quickly stop a directed action when a stop signal is introduced into the activity and is thus a test of response inhibition. The computer screen shows an arrow facing left or right. The participant must press the corresponding left or right arrow on the keyboard. However, occasionally a beep will sound. When the beep sounds the participant attempts to withhold their motor response (Aron, 2007; Logan, Cowan, & Davis, 1984).

2.1.3. Cambridge Gambling Task (CGT)

The CGT assesses decision-making and risk-taking behavior by examining the participants' behavior when presented with a gambling situation. The computer screen shows 10 boxes in varying ratios of blue and red color. Behind one of the 10 boxes is a token. The participant must first decide which color box he or she believes has a higher probability of hiding the coin. They then must decide how many imaginary points they want to bet on their guess. Possible bets first start at lower values and steadily increase. Halfway through the task the direction of possible bets reverses and possible bets start at higher values and steadily decrease. The participant must press the screen when their desired bet presents itself (Rogers et al., 1999).

2.2. Statistical analysis

To identify demographic and clinical measures associated with weekly caffeine intake in gamblers, we utilized the statistical technique of partial least squares (PLS) (Garthwaite, 1994; Höskuldsson, 1988; Wold, 1966; Wold, Sjöström, & Eriksson, 2001). PLS approach was used instead of a multiple linear regression as it is a suitable statistical tool when there are a number of factors being examined along with a small sample size. This is an iterative multivariate technique that constructs one or more latent factors (PLS components) that optimally explain