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Cognitive flexibility correlates with gambling severity in young adults

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ABSTRACT

Although gambling disorder (GD) is often characterized as a problem of impulsivity, compulsivity has recently been proposed as a potentially important feature of addictive disorders. The present analysis assessed the neurocognitive and clinical relationship between compulsivity on gambling behavior. A sample of 552 non-treatment seeking gamblers age 18–29 was recruited from the community for a study on gambling in young adults. Gambling severity levels included both casual and disordered gamblers. All participants completed the Intra/Extra-Dimensional Set Shift (IED) task, from which the total adjusted errors were correlated with gambling severity measures, and linear regression modeling was used to assess three error measures from the task. The present analysis found significant positive correlations between problems with cognitive flexibility and gambling severity (reflected by the number of DSM-5 criteria, gambling frequency, amount of money lost in the past year, and gambling urge/behavior severity). IED errors also showed a positive correlation with self-reported compulsive behavior scores. A significant correlation was also found between IED errors and non-planning impulsivity from the BIS. Linear regression models based on total IED errors, extra-dimensional (ED) shift errors, or pre-ED shift errors indicated that these factors accounted for a significant portion of the variance noted in several variables. These findings suggest that cognitive flexibility may be an important consideration in the assessment of gamblers. Results from correlational and linear regression analyses support this possibility, but the exact contributions of both impulsivity and cognitive flexibility remain entangled. Future studies will ideally be able to assess the longitudinal relationships between gambling, compulsivity, and impulsivity, helping to clarify the relative contributions of both impulsive and compulsive features.

1. Introduction

Gambling disorder (GD) is defined as persistent problematic gambling behavior that is also associated with significant distress or impairment (American Psychiatric Association, 2013). The clinical aspects of GD have often been regarded as impulsive, in that they are often poorly thought out (or undertaken without adequate forethought), risky, and result in deleterious long-term outcomes (Chamberlain and Sahakian, 2007). Furthermore, neurocognitive research has found that GD is frequently associated with heightened trait impulsivity (for example, measured by the Barratt Impulsiveness Scale-11), although the exact nature of this neurocognitive trait remains somewhat ill-defined, with associations differing by the measures used, the disorder(s) of interest, and the trait versus state aspects of impulsivity i.e. state impulsivity measured by behavioral tasks such as the Stroop Color Word Test and the Emotional Conflict Task (Leppink et al., 2016; Choi et al., 2014; Grant and Kim, 2014; el-Guebaly et al., 2012; Leeman and Potenza, 2012; Probst and van Eimeren, 2013; Lai et al., 2011). In addition, previous studies have shown that certain measures of impulsivity show significant associations with GD symptom severity, although this has not always been true (Blanco et al., 2009; Bottesi et al., 2014; Grant and Kim, 2014; Ledgerwood et al., 2012).

One conceptualization holds that impulsivity (tendency towards premature, poorly thought out acts) is diametrically opposed to compulsivity (i.e. thoughts and behaviors that are repetitive, and performed in a stereotyped or habitual fashion), with impulsivity and compulsivity representing opposing ends of a behavioral spectrum (Hollander and Cohen, 1996). Alternatively, the two terms may be seen as overlapping, in that they both imply underlying

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problems with top-down inhibitory control (Fineberg et al., 2014). Compulsivity has mostly been considered in terms of the 'archetypal' disorder of compulsivity, namely obsessive compulsive disorder (OCD). Further complicating our understanding of GD, recent genetic research suggests that GD may be linked with OCD (Sherrer et al., 2015), and thus perhaps characterized by compulsive features. While the presentation of compulsivity in GD may not mirror what is typically seen in a disorder such as OCD (Fineberg et al., 2010), a few studies have found elevated compulsive traits and behaviors in gamblers compared to healthy controls (Goudriaan et al., 2006; Ledgerwood et al., 2012; Grant and Potenza, 2006). Thus, while gambling is frequently considered an impulsive behavior, it may also show associations with compulsivity.

Although considerable research has focused on fractionating impulsivity such as in terms of cognitive tests and disorders (Dalley et al., 2011), the concept of compulsivity is perhaps less fully developed. Flexible responding, arguably one important aspect of compulsivity, has traditionally been assessed with the Wisconsin Card Sorting Test (WCST) and its variants, which are dependent on distributed neural circuitry including the ventromedial and ventrolateral prefrontal cortices (Hampshire and Owen, 2006; Buckley et al., 2009). Consequently, the majority of available studies have reported on WCST performance in gambling disorder compared with healthy controls. Results are conflicting, with some studies reporting deficits among gamblers (Rugle and Melamed, 1993; Goudriaan et al., 2006; Forbush et al., 2008; Marazziti et al., 2008) and others showing no deficits (Cavedini et al., 2002; Brand et al., 2005) in overall cognitive flexibility. Previous research has found that adults with problem gambling behavior exhibit reversal learning perseveration, another way to examine compulsivity, compared with controls (Leeman and Potenza, 2012). Finally, problem gamblers exhibit reduced flexibility after reversal of previously rewarded contingencies (Vanes et al., 2014).

The goal of the present study was to assess whether compulsivity, rather than impulsivity, has different and perhaps clinically more useful associations with gambling severity. This study, therefore, examined the concept of compulsivity using the Intra-/Extradimensional Set Shifting task (IED), a computer-based measure of cognitive flexibility which has previously been proposed as a meaningful domain of compulsivity (Fineberg et al., 2015; Wu et al., 2014), and the Padua inventory, a questionnaire-based measure of obsessionality/compulsivity typically associated with compulsive disorders. Several studies have found significant associations between elevated questionnaire-based measures of compulsivity and impaired cognitive flexibility (using the WCST) (Gershuny and Sher, 1995; Goodwin and Sher, 1992).

We hypothesized that as the number of errors gamblers made during the IED increased (i.e. greater cognitive inflexibility) there would be a there would be a corresponding increase in gambling symptoms severity as well as psychosocial variables. We also predicted a significant association between IED errors and scores on the Padua Inventory, as both assess certain facets obsessionality/compulsivity.

2. Methods

2.1. Subjects

Subjects were 552 non-treatment seeking young adults age 18 to 29 recruited from the surrounding community near two urban universities in the Midwest for a study on gambling behavior in young adults. Inclusion criteria were a gambling frequency of at least five times in the past year and ability to provide written informed consent for all study procedures. Exclusion criteria were an inability to understand/undertake the assessments, and failure to provide written informed consent. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

2.2. Assessments

2.2.1. Demographics and psychiatric

All participants provided basic demographic information at baseline, including age, sex, race, and education. Participants were also asked about current nicotine, alcohol, and cannabis use. All participants were screened using the Mini International Neuropsychiatric Inventory (MINI) (Sheehan et al., 1998) by trained raters. Raters also assessed participant history of other impulse control disorders using the Minnesota Impulse Disorders Interview (MIDI) (Grant, 2008).

2.2.2. Gambling

2.2.2.1. Structured clinical interview for pathological gambling, DSM-5 (SCI-PG). The SCI-PG is a nine question, clinician-administered scale for the diagnosis of GD based on DSM-5 criteria. A total of 4 + current symptoms is consistent with a diagnosis of current GD (Grant et al., 2004). The scale examined symptoms over the past 12 months.

2.2.2.2. Yale-brown obsessive-compulsive scale modified for pathological gambling (PG-YBOCS). The PG-YBOCS is a ten question clinician-administered measure of gambling severity which assesses urges and behavior related to gambling independently. Questions are scored from 0 (none) to 4 (extreme). Behavior and urge scores are then added to provide a total severity score (Pallanti et al., 2005). The PG-YBOCS measures severity of gambling over the last seven days.

In addition to structured assessments, participants completed assessments of social, financial, legal, and work problems stemming from gambling, as well as the total amount of money lost gambling in the past year and average gambling frequency per week.

2.2.3. Compulsivity/cognitive flexibility

2.2.3.1. Intra-/extradimensional set shifting task (IED). The IED is a computerized set shifting task which assesses cognitive flexibility. The IED paradigm, which decomposes different aspects of rule learning and flexible responding, was derived from the Wisconsin Card Sorting Test, and was taken from the computerized Cambridge Neuropsychological Test Automated Battery (CANTABeclipse, version 3, Cambridge Cognition Ltd, UK). During the task, participants are initially presented with a screen showing four boxes, two of which are blank, and two of which contain distinct pink shapes. Participants are informed that one shape displayed is "correct", and the other is "incorrect", based on a rule set by the computer, and their goal is to select the correct shape as many times as possible. After a set number of correct selections, the computer automatically changes which shape is correct, which is defined as the intradimensional set shift (ID), a process which is then repeated several times. After another period of correct responses, the task introduces a second set of stimuli, distinct white shapes, as another variable that are overlaid on top of the pink shapes. During this phase, the computer begins to identify the white shapes as the correct and incorrect variables, rather than the pink shapes, which is described as the extradimensional set shift (ED). The target variable for this analysis was the total number of errors made during the task adjusted for the total number of stages successfully completed.