Pathological gambling and impulsivity: Comparison of the different measures in the behavior inhibition tasks

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Impulsive behavior and underlying brain processes are hypothesized to be central in the development and maintenance of pathological gambling. Inhibition ability can be differentially impaired in pathological gamblers (PGs). The goal of this cross-sectional study is to compare common inhibition measures in the discrimination of PG and healthy controls (HC). PG (N = 51) and HC (N = 51) performed the “response inhibition” (the Go/No-go), the “interference inhibition” (the Stroop), and the “reflective inhibition” (the Matching Familiar Figures, MFFT) tasks. Augmented total interference response time in the Stroop task ($\eta^2 = 0.054$), high number of commission errors ($\eta^2 = 0.053$) in the Go/No-go task, and total number of errors in the MFFT ($\eta^2 = 0.05$) can discriminate PGs. Slow response time in the Go/No-go task ($\eta^2 = 0.038$) has borderline ability, but the number of errors in the incongruent condition, total interference in terms of error rate, number of omissions in the Go/No-go task, and first response time in the MFFT could not differentiate between the PG and the HC. There were no significant correlations between inhibition measures. Most inhibition measures are not relevant to gambling. PGs do not express rash impulsive behavior such as quick answer without thinking. In contrary, the inhibition impairment was related to slow-accurate performance.

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1. Introduction

Pathological gambling is characterized by gambling behavior that significantly impairs occupational, interpersonal, and financial functioning (National Opinion Research Center, 1999). Both the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR, 2004) and the International Statistical Classification of Diseases and Related Health Problems (ICD-10, 2003) have classified pathological gambling as a disorder of impulse control. Impulsive behavior and underlying brain processes are thought to be central in the development and maintenance of both pathological gambling and addiction (Leeman & Potenza, 2012). The new DSM-5 puts pathological gambling in the category of “behavioral addiction” (DSM-5, 2013) because impaired ability to control behavior is specified in at least one of the DSM-5 criteria for substance use disorders.

Alongside high impulsivity, both substance abusers and pathological gamblers (PGs) suffer from poor inhibitory control (Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2008; Verdejo-Garcia, Lawrence, & Clark, 2008). Impulsivity, as assessed by self-report measures, may be qualitatively different from impulsivity as assessed by behavioral performance on inhibition-related tasks. This might be because high impulsive individuals have different degrees of insight into their disinhibited behavior. In PGs, inhibition impairments were suggested to be the key factor underlying an inability to quit gambling inside a casino after losing a certain amount of money (see van Holst, van den Brink, Veltman, & Goudriaan, 2010 for review).

Inhibition reflects a set of overlapping cognitive processes that are distinct at the neural level (Eagle, Bari, & Robbins, 2008). The construct of each inhibition paradigm- varies substantially and reflects the non-unitary characteristic of impulsivity (Dalley, Everitt, & Robbins, 2011). Research does not stipulate any clear rationale for selecting a particular measurement paradigm for inhibition (Nigg, 2000) or for impulsivity (Carrillo-de-la-Peña, Otero, & Romero, 1993). Impulsive behavior is mostly viewed as being a function of inhibitory control and the ability to suppress undesirable response tendencies (Logan, Schachar, & Tannock, 1997). Several cognitive paradigms can quantify this inhibition including the following:

- “Response inhibition” is the inability to inhibit pre-potent courses of action (Nigg, 2000). In the Go/No-go task, three measures were used as index of impulsiveness: 1) the high number
of commission errors is as expression of low behavioral inhibition (Newman, 1987), 2) in pathological gamblers and controls the low number of omission errors, because a high rate of omission errors is related to too much behavioral inhibition (Yechiam et al., 2006); and 3) slowness of response time (Exposito & Andres-Pueyo, 1997). Cheung, Mitis, and Halperin (2004) found that in the Go/No-go task, the slowness of the reaction time is a more sensitive measure of impulsivity than the high number of commission errors.

(b) “Interference inhibition” is the ability to maintain a response performance during the presentation of competing stimuli in the Stroop task (Logan, 1980). This task requires participants to respond to the stimuli and suppress the overlearned response. The impulsive behavior can be attributed to 1) slowness of responses (Barratt & Patton, 1983; Logan, 1980); 2) weaker interference control—both in terms of the relative response delay in the Stroop incongruent condition versus neutral or congruent conditions (see MacLeod, 1991 for review; Lansbergen, van Hell, & Kenemans, 2007), or as increasing the number of the errors in the incongruent condition (White et al., 1994); and 3) increased number of total errors in all conditions because errors were more preferable measure for the reason that they were more normally distributed than reaction time (White et al., 1994).

(c) “Reflection impulsivity” is the tendency toward rapid action before sufficient information is gathered (Kagan, Rosman, Day, Albert, & Phillips, 1964). Kagan et al. (1964) introduce conceptualization of impulsivity in a situation without time pressure as inability to gather and evaluate information before responding in a condition with several highly plausible alternatives—only one of which is correct. Impulsive behavior is associated with the degree to which an individual favors speed over accuracy (Dickman, 1990). Impulsive subjects tend to quickly choose an answer without thinking, and their performance is associated with short latencies and a high numbers of errors (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Therefore, the fast-incorrect subtype of responses was introduced as the key measure of impulsivity (Phillips & Rabbit, 1995). This type of behavior can be detected by 1) the fast first response and 2) high total number of errors in the Matched Familiar Figure Test (MFFT) (Kagan et al., 1964). Although these three categories fit well with theory and empirical evidence and correspond with several widely accepted operational definitions, the exact nature of the dimensions remains controversial, and there is evidence for both relatedness (Reynolds, Ortengren, Richards, & de Wit, 2006) as well as independence (Smith et al., 2007) among the measures. Clinically, being able to divide inhibition into several distinct behavioral subtypes would be important if each of these subtypes could be defined pharmacologically and psychologically, and if the subtypes could be distinguished from one another using a task that can assess specific aspects of impulsivity (De Wilde, Goudraan, Sabbe, Hulstijn, & Dom, 2013).

Previous studies were not consistent in their conclusion of inhibition impairments among PGs (see van Holst et al., 2010 for review). More recent studies also were not congruent. Lai, Ip, and Lee (2011) found no differences in PG during Stroop performance versus HC, but Álvarez-Moya et al. (2011) found weak, non-significant associations between Stroop interference scores and risk of relapse in PG. It may be possible that contradiction of results in PGs between studies used inhibition tasks may be related to differences in specific measures among each task. Ledgerwood et al. (2011) suggest that the mechanism of risk-taking behavior in PG is not clear. To determine what measures of specific inhibition process may contribute to the better discriminate performance of PG from HC, we focus on the eight previously suggested measures of Go/No-go, the Stroop or the MFFT tasks. Simultaneous administration of different inhibition tasks and the use of wide range measures in these tasks among the same participants may create difficulties around integration of contradicted results. Studies that have incorporated inhibition measures from multiple paradigms are limited (Perales, Verdejo-Garcia, Moya, Lozano, & Pérez-Garcia, 2009) especially in the PG population (Billieux et al., 2012; De Wilde et al., 2013). Studies using inhibition assessment have tended to use a single task. Our previous works (Kertzman et al., 2006; Kertzman et al., 2008; Kertzman et al., 2010), like many others, were focused on the analysis of specific inhibition abilities among PG subjects via only a single task. On the other hand, the Stroop, the Go/No-go, and the MFFT tasks can be similar impaired because they all require the ability to inhibit pre-potent responses. Thus, the performance measures of these three tasks might be positively correlated.

This study offers new insight into the question: Do different impulsivity measures have a comparable discriminant ability to dissociate PG from HC during performance on the Go/No-go, the Stroop or the MFFT tasks? In addition, there has been little systematic investigation of associations between different inhibition measures in PG, and this is studied here.

2. Method

2.1. Participants

For this study’s experimental group, 51 PG were recruited by PND from ambulatory services throughout Israel. All PGs were assessed in the centers’ ambulatory clinics. Some data of these participants has been partially previously reported (Kertzman et al., 2006, 2008, 2010). Of the 51, 13 patients were sport gamblers; 10 were scratching gamblers who gambled using lottery tickets; 23 were card playing gamblers or gamblers using casino slot machines; and 5 were Internet gamblers (the total number is relatively high because there are no legal casinos in Israel). All patients were active gamblers who had last gambled less than a month prior to this study.

We expected that comorbid alcohol and drug dependence as well as neurological problems would cause additive effects on their neuro-cognitive performances. Thus, the exclusion criteria were neurological disorders, mental retardation, alcohol and substance abuse/dependence, major psychiatric disorders, and treatment with any psychiatric medication in the month before the screening interview. A senior psychiatist (PND) administered a semi-structured diagnostic interview, which was performed according to the guidelines of DSM-IV-TR and the South Oaks Gambling Scale (SOGS; Lesieur & Blume, 1987). The SOGS is a 20-item psychometrically-validated measure of pathological gambling. Items reflect symptoms of pathological gambling and a criterion score of five, which is recommended for identifying pathological gamblers (Lesieur & Blume, 1987). The SOGS converges with the DSM-IV-TR diagnosis for pathological gambling (Stinchfield, 2002). Patients who met the SOGS at <$5 were excluded.

The control group included 51 healthy controls (HC), and they were recruited among the staff members, their relatives and medical students by another senior psychiatrist (SK). Potential participants completed a screening interview that covered the following areas: medical history, illicit drug use, family and personal psychiatric history, and severe visual impairment. All participants had been free of any psychopharmacologic treatment for at least four weeks prior to the study. Participants were excluded if they demonstrated signs of lifetime substance use disorders (with the exception of caffeine or nicotine abuse or dependence), axis 1 disorders, psychotic disorders, organic deterioration or amnesic disorders, physical handicaps, or severe somatic disorders. The participants did not seek medical treatment at the time and lacked any form of history of gambling dependence. Thus the SOGS was not administered to the controls because of their lack of gambling behavior.

Our study was approved by the Local Ethics Committee (adult population studies) that is supervised by the Israeli Ministry of Health. All
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