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Dimensions and disorder specificity of impulsivity in pathological gambling

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HIGHLIGHTS

- We found four impulsivity-related dimensions with a comprehensive task battery.
- The corresponding impulsivity profile of pathological gambling (PG) was investigated.
- PG is related to an overall heightened impulsivity profile compared to healthy controls.
- The impulsivity profile of PG is similar to those of alcohol dependence.
- PG is related to higher 'choice impulsivity' compared to Gilles de la Tourette syndrome.

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ABSTRACT

Impulsivity is a core characteristic of pathological gambling (PG), even though the underlying structure and disorder specificity is unclear. This study aimed to explore different dimensions of impulsivity in a clinical sample including PG. Furthermore, we aimed to test which alterations of the impulsivity-related dimensions are disorder specific for PG. Participants were individuals diagnosed with PG ($n = 51$) and two groups also characterized by various impulsive behaviors: an alcohol dependence (AD; $n = 45$) and a Gilles de la Tourette syndrome (GTS; $n = 49$) group. A healthy control (HC; $n = 53$) group was recruited as comparison group. A comprehensive assessment was used including impulsivity-related and antipodal parameters of the Stop Signal Task, Stroop Task, Tower of London Task, Card Playing Task, Iowa Gambling Task and the Barratt Impulsiveness Scale-11. Principal axis factor analysis revealed four impulsivity-related dimensions that were labeled 'self-reported impulsivity', 'prepotent response impulsivity', 'choice impulsivity' and 'motor impulsivity'. The PG group scored significantly higher on all four dimensions compared to the HC group. In contrast, the PG group did not differ on any of the dimensions from the AD or the GTS group, except for 'choice impulsivity' where the PG group exhibited higher factor scores compared to the GTS group. Altogether, PG is associated with generally heightened impulsivity profiles compared to a HC group, which may be further used for intervention strategies. However, heightened scores in the impulsivity dimensions are not disorder specific for PG. Further research on shared or different underlying mechanisms of these overlapping impulsivity impairments is necessary.

1. Introduction

Over the past years, a substantial body of research has highlighted that impulsivity is an important etiological factor for pathological gambling (PG; e.g., Shenassa, Paradis, Dolan, Wilhelm, & Buka, 2012; Verdejo-Garcia, Lawrence, & Clark, 2008). Our study aimed to explore the multidimensional nature of impulsivity in a sample including PG and to elucidate which patterns of impulsivity-related alterations are disorder specific for PG.

The clinical as well as the neuropsychological picture PG has been characterized by increased impulsivity (American Psychiatric Association (APA), 2000, 2013; van Holst, van den Brink, Veltman, & Goudriaan, 2010b; Verdejo-Garcia et al., 2008). The construct can be broadly defined as the tendency to act rapidly upon stimuli or inner impulses

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that may result from a lack of adequate forethought and/or a reduced ability to inhibit prepotent or habitual responses (Evenden, 1999; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). However, there has been an inconsistent conceptualization of impulsivity, possibly resulting from a remarkable diversity of (1) underlying causes (Bickel, Jarmolowicz, Mueller, Gatchalian, & McClure, 2012), (2) dimensions of the construct (Dick et al., 2010) and (3) resulting behavioral expressions as well as an unsystematic interrelation of those three levels (Enticott & Ogloff, 2006). Research on the construct level of impulsivity has shown its multidimensional nature (e.g., Broos et al., 2012; Ginley, Whelan, Meyers, Relyea, & Pearlson, 2013; Moeller et al., 2001; Whiteside & Lynam, 2001) and confirmed that comparable impulsivity dimensions exist in healthy people and clinical groups (Meda et al., 2009). To apply this multidimensional approach of impulsivity in PG research would importantly increase knowledge on PG-specific patterns of impulsivity alterations (e.g., increased choice impulsivity) and help to clarify underlying processes (e.g., devaluation of future rewards; Bechara, 2003; Bühringer, Wittchen, Gottlebe, Kufeld, & Goschke, 2008; Redish, Jensen, & Johnson, 2008). Up to now, only one study showed differences of non-gamblers, low-risk gamblers and symptomatic gamblers (one or more PG criteria) in three impulsivity dimensions (Ginley et al., 2013). Unfortunately, PG was not diagnosed in this study, and the impulsivity dimensions that were used merely relied on self-reports which may not cover the full impulsivity spectrum (Broos et al., 2012; Enticott & Ogloff, 2006).

A multidimensional conceptualization of impulsivity further allows a comparison of patterns of impulsivity impairments between PG and other mental disorders. This is highly important since heightened impulsivity is a core characteristic of various other mental disorders than PG, including substance use disorders (SUDs) or neurodevelopmental disorders like attention deficit/hyperactivity disorder (ADHD) or Gilles de la Tourette syndrome (GTS) (e.g., Eddy, Rizzo, & Cavanna, 2009; Moeller et al., 2001; Rogers, Moeller, Swann, & Clark, 2010; Swann, Bjork, Moeller, & Dougherty, 2002). Previous studies comparing impulsivity in PG with other mental disorders (e.g., Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005, 2006a; Kalechstein et al., 2007; Lawrence, Luty, Bogdan, Sahakian, & Clark, 2009a, 2009b; Leeman & Potenza, 2012) focused on the behavioral level of impulsivity where the construct is operationalized with task scores (Dick et al., 2010; Moeller et al., 2001). However, it would be advantageous to use factor scores when comparing PG with other mental disorders since a reduction of task-specific and error variance can be achieved (Aichert et al., 2012; Miyake & Shah, 1999), and clearer conclusions regarding differences on the causal level can be drawn.

Against this background, our first research question concerns the multidimensional nature of impulsivity in a sample including individuals with PG. We assumed to explore at least two impulsivity-related dimensions, including response impulsivity and choice impulsivity (according to, e.g., Bickel et al., 2012; Dalley, Everitt, & Robbins, 2011; Kim & Lee, 2011).

Furthermore, it is important to study which impulsivity dimensions are specifically altered in PG to have a better insight in altered brain processes. For this second research question, we compared PG with healthy controls as well as with individuals with alcohol dependence (AD) or GTS. AD and GTS are important comparison groups for PG because both disorders have been shown to be associated with impulsive behaviors (e.g., Eddy et al., 2009; Rogers et al., 2010). We hypothesized that individuals with PG would score higher on all impulsivity-related dimensions compared to the healthy control group. Regarding disorder specificity, we assumed that there would be differences in choice impulsivity between the PG group and the AD and GTS groups since PG may be related to stronger disorder-specific alterations in the valuation and motivation-related brain systems (e.g., Goudriaan et al., 2005; Kräplin et al., 2014). From a clinical point of view, those patterns of impulsivity impairments would provide evidence for effective therapy supplements.

2. Methods

2.1. Participants and procedure

Four groups aged 18 to 60 years were investigated in the study: 51 individuals diagnosed with PG, 45 individuals diagnosed with AD and 49 individuals diagnosed with GTS and 53 healthy control (HC) individuals. Results regarding neurocognitive deficits in this sample have been published elsewhere (Goudriaan et al., 2005, 2006a; Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2006b), where a detailed description of recruitment and screening procedures can be found. The sample used in this study largely overlaps with the early reported studies, although the numbers of participants differs slightly for reasons related to missing data for the factor analysis (see Section 2.3).

PG and AD were diagnosed according to DSM-IV (American Psychiatric Association (APA), 2000), and GTS was diagnosed by a psychiatrist or neurologist. We performed a group-based matching of the PG group and the AD, GTS and HC in terms of age, gender and intelligence. Demographical characteristics for the four groups are presented in Table 1. Current nicotine dependence was assessed with the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991). Despite the attempt to match the groups and partly due to the exclusion of some participants with missing data, the groups differed significantly in age, gender and nicotine dependence. In order to prevent bias, we used those variables as covariates in the analyses. Exclusion criteria for all groups were other lifetime comorbid mental disorders than studied (including other SUDs, except for nicotine dependence). The three disorder groups were mutually exclusive with regard to the mental disorder under study. The study protocol was approved by the Medical Ethics Committee of the Academic Medical Centre of the University of Amsterdam.

2.2. Measures

2.2.1. Stop signal task

The stop signal task was modified by Scheres, Oosterlaan and Sergeant (2001). A total of six blocks with 64 trials were administered of which the first block was only used for training purposes, and not included in the statistical analysis. Participants were instructed to respond as fast as possible. In 75% of the trials, a 'go' signal occurred and in 25% of the trials a stop signal occurred at a variable delay (stop signal delay), which was calculated using an algorithm that resulted in a 50% successful inhibition rate. The dependent measure was the Stop Signal Reaction Time (SSRT), which was computed as the difference between mean reaction time on go trials and the averaged stop signal delay. A slower SSRT was suggested as an indicator of impaired response inhibition.

2.2.2. Stroop Task

The Stroop Task consisted of three cards, each with 100 items. Card 1 contained color words printed in black, card 2 contained rectangles printed in different colors and card 3 contained words printed in incongruent colors. Participants had to name the words (card 1) or the colors (cards 2 and 3) as fast as possible. The dependent variable of this task was the interference score calculated as the difference in the reading time between card 2 and card 3. Impaired response inhibition was indicated by a higher interference score.

2.2.3. Tower of London Task

It has been suggested that different dimensions of impulsivity have an antipode in executive functioning like planning, i.e., that both concepts are widely separated on a shared continuum and can be assessed with overlapping measurements (Bickel et al., 2012). Indeed, various studies suggest that performance in planning tasks like the Tower of London Task can be (partly) attributed to inhibition abilities (Baughman & Cooper, 2007; Mitchell & Poston, 2001; Miyake et al., 2000; Zook, Davalos, DeLosh, & Davis, 2004). In this task, participants