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Review

Decision making measured by the Iowa Gambling Task in alcohol use disorder and gambling disorder: a systematic review and meta-analysis

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ABSTRACT

Background and aims: Gambling disorder (GD) and alcohol use disorder (AD) have similar features, such as elevated impulsivity and decision-making deficits, which are directly linked to relapse and poor therapeutic outcomes. Our aim was to assess decision-making characteristics in GD and AD patients compared to healthy controls (HC) based on one of the most frequently used measures of decision-making: the Iowa Gambling Task (IGT).

Methods: In our systematic literature search of three databases, we identified 1198 empirical articles that mentioned decision-making deficits with the use of the IGT in patients diagnosed with either AD or GD. Possible effects were calculated using meta-analysis. In the end, 17 studies (including 1360 participants) were suitable for inclusion in the meta-analysis reporting data for 23 group contrasts.

Results: The random effects estimate indicated impaired IGT performance in both AD patients (N = 500; d = −0.581, CI:-89.5 < δ < −26.6%) and an even greater deficit in GD patients (N = 292; d = −1.034, CI:-156.1 < δ < 50.7%) compared to HCs. Sampling variances were calculated for both AD (v_1 = 0.0056) and GD groups (v_2 = 0.0061), from which the z-score was calculated (z = −21.0785; p < 0.05), which indicates a statistically significant difference between AD and GD groups. No significant moderating effects of age, gender or education were found.

Conclusions: There is enough evidence to support that decision-making deficit associated with addictive disorders, and that the deficit is more expressed in gambling disorder than in alcohol use disorder. Impaired decision-making plays an important part in poor therapeutic outcomes, thus provides a promising opportunity for cognitive intervention.

1. Introduction

Gambling disorder (GD) is currently the only non-substance related addiction listed under “Substance-Related and Addictive Disorders” in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association, 2013). Substantial empirical evidence has highlighted similarities and common features between GD and other substance related disorders, particularly alcohol use disorder (AD) (Petry et al., 2014). One of the similarities between GD and AD is cognitive impulsivity, which stems from maladaptive decision-making strategies, and what is generally considered to be a strong predictor of behaviour and treatment outcomes (Krishnan-Sarin et al., 2007; Moeller et al., 2001; Verdejo-García et al., 2007).

Recent etiological studies report that GD and AD are highly comorbid both in community (Cunningham-Williams et al., 1998; Petry et al., 2005; Welte et al., 2001) and treatment seeking groups (Feigelman et al., 1998; Stinchfield et al., 2005). One of the possible reasons behind this elevated comorbidity is the biological and phenomenological similarity between GD and AD. Studies demonstrated that GD and AD have mutual underlying genetic (Blanco et al., 2006; Slutske et al., 2010), epidemiological (Cunningham-Williams et al., 1998; Petry et al., 2005), and etiological (Kessler et al., 2005; Welte et al., 2001) factors. The two disorders share common symptomatology such as craving (de Castro et al., 2007), withdrawal symptoms and tolerance (Blaszczynski et al., 2008), frequent or multiple relapses (Ledgerwood and Petry, 2006), the use of inadequate coping mechanisms (Crocq, 2003), and/or failure in response inhibition (Lawrence et al., 2009a).

Besides biological and psychological factors, social context is also an important domain of gambling and drinking behaviour. There is

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evidence that higher prevalence of problem gambling is closely linked to the availability and expansion of gambling venues, where alcohol is commercially available (Markham et al., 2012). Multiple studies also reported that both GD and AD show similar differences concerning gender, age and education. Gender ratios (male/female) for the prevalence rates in high frequency and high-volume drinking indicated that men drink on more days per week and consume more grams of ethanol per day than women in every age group (Wilsnack et al., 2009); same applies in GD, where women are also less likely to have gambling problems (odds ratio = 0.16) (Stoltenberg et al., 2008). Younger age of onset was related to greater symptom severity and number of dependence episodes in both diseases. Those who began drinking before the age of 14 had higher risk of developing lifetime alcohol dependence (HR: 1.78; 95% CI: 1.51-2.11) and were almost three times more likely to have experienced more than two dependence episodes at the same time of assessment (OR: 2.89; 95% CI: 1.97-4.23) compared to those who started drinking after the age of 25 (Hingson et al., 2006). Similarly, younger age of onset was associated with greater symptom severity and more treatment dropout (OR = 0.976; 95% CI: 0.954-0.998) (Jiménez-Murcia et al., 2010). The level of education and problem gambling/drinking and dependence show an inverse relationship, given that people without tertiary education are more prone to develop AD (estimated relative risk for people with 9–12 years of completed education is six-fold compared to those who obtained a college degree where the estimated relative risk is three-fold) and/or GD (those who left school before year 10 were 2.6 times more likely to develop problematic gambling compared to those who obtained an university degree) (Brunborg et al., 2016; Sproston et al., 2012). Moreover, GD and AD also share common neurobiological processes in the regards of underlying urges and reward sensitivity. Studies conducted in this field indicate that both diseases stem from similar underlying mechanisms.

Regarding such mechanisms, clinical and preclinical studies reported that this mechanism involves a specific brain system, the ventral tegmental area – nucleus accumbens – orbital frontal cortex circuit that processes incoming reward inputs (Blum et al., 1995; Gilpin and Koob, 2008; Potenza, 2013, 2001). Another process strongly linked to the reward and punishment system is the process of decision-making. Based on the extensive literature body on decision-making, impulsivity is frequently mentioned in connection with the weaknesses of decision-making (Franken et al., 2008; Morgan et al., 2006). Consequently, highly impulsive individuals tend to disregard the consequences of their decisions. Decision-making may be the key feature of understanding both GD and AD. Decision-making is considered to be a facet of impulsivity, which is a topic widely addressed throughout the scope of addictive disorders. Bechara (2005) described decision-making as a complex set of cognitive processes which allow individuals to select the most optimal course of action following reasoned consideration of existing alternatives. The measurement of decision-making in addictive disorders mainly focuses on the assessment of performance-based neurocognitive tasks often compared to other cognitive variables like executive functions or intelligence. People suffering from AD and/or GD show similar features in various decision-making tasks. Impaired inhibitory control was measured by the Stop Signal Reaction Time and the Stroop Color and Word Test, compared to HC group; the authors found no statistically significant difference between AD and GD patient groups in the aforementioned domains (Goudriaan et al., 2006). This similarity was also supported using the Cambridge Gamble Task, where GD and AD also exhibited impaired decision-making (Lawrence et al., 2009b).

One of the most frequently used and ecologically valid assessment tools for measuring decision-making is the Iowa Gambling Task (IGT), which is a computerized neuropsychological task in which participants are shown 4 virtual decks of cards (labelled A, B, C, and D) and are asked to choose 100 times from the decks. In each selection, they win or lose money with the deck they selected, and the goal is to win as much money as they can. With each selection, participants can either win, or win and lose at the same time; each deck differs from each other in the ratio of wins and losses. Decks labelled C and D are considered advantageous; they result in more monetary wins and fewer losses on the long run. This means that the participant is more likely to have gained money than to have lost (i.e., “You won €100, and You lost €40”, making a profit of €60 on this single choice)". On the other hand, decks with label A or B are disadvantageous, and likely to result in loss (i.e., “You won €40, and You lost €100”, making a loss of €60 on this single choice). Therefore the series of decision results in profit or loss over multiple choices by the end of the experimental task. Healthy persons are likely to learn the rule after 40–50 trials and choose from the profitable decks, but impulsive participants are likely to persevere with the loosing decks making a monetary loss by the end of the game (Bechara et al., 1994; Bechara et al., 1997). Participants are informed in the beginning of the task that some decks are more profitable than others. During the task they easily learn which decks are “good” and which are “bad” and make choices accordingly. The IGT net score is calculated by subtracting the total number of selections from disadvantageous decks (A + B) from the total number of selections from advantageous decks (C + D). One of the main reasons for its popularity is that the IGT models real-life decision-making under laboratory circumstances (Bechara et al., 1997). Unlike self-reported questionnaires of impulsivity, which are prone to bias due to individual differences in self-reflection, the IGT has the potential to be used as a direct evaluation method of measuring impulsivity (Bechara et al., 1994; Bechara et al., 1997). For best performance on the IGT, participants have to abandon short-term advantageous choices (resulting in immediate high rewards) that turn out to be disadvantageous in the long run (higher losses/punishments). Instead, participants must prefer long-term advantageous choices, which result in lower immediate rewards but lower long-term losses as well, thus higher long-term gain.

People with GD and AD also tend to show impaired decision-making measured by the IGT. While there is significant empirical data concerning the decision-making processes of these disorders, the comparison of decision-making among patients with these two disorders is scarce (Goudriaan et al., 2005). It is reported that the two diseases have high comorbidity rates. Moreover, numerous empirical studies examine decision-making in AD and GD.

The elevated level of impulsivity is closely connected to the ability and willingness to take risks and make risky decisions in real-life situations. This affects everyday life behaviour in several ways; the severity of poor decision-making, the loss of ability to control temptation and the lack of willpower to resist substance use or gambling activity are closely connected to relapse and poorer therapeutic outcomes in addictive disorders (Franken et al., 2008; Lawrence et al., 2009a). This emphasizes the importance of dimensionality in the research and treatment of addictive disorders which is in line with official diagnostic trends (American Psychiatric Association, 2013). A comprehensive synthesis of existing knowledge about decision-making in GD and AD and the understanding of the existing differences could provide clinically relevant and important information regarding possible cognitive interventions. Also, it could point out directions for further detailed studies.

1.1. Aims of the study

Since the characteristics of decision-making and its relevance in the clinical pictures of AD and GD is of high importance, the main aim of this study is to systematically review empirical data concerning decision-making in patients diagnosed with GD or AD compared to healthy control (HC) groups. Moreover, this is the first meta-analysis to explore whether patients with GD and AD report similarities in the characteristics of decision-making using one of the most popular measures of cognitive impulsivity, the Iowa Gambling Task (IGT).