Drug and Alcohol Dependence 172 (2017) 21–33

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Review

Meta-analysis of the relationship between impulsivity and substance-related cognitive biases

Daniel Leung[a], Petra K. Staiger[a,*], Melissa Hayden[a], Jarrad A.G. Lum[a], Kate Hall[a,b], Victoria Manning[c], Antonio Verdejo-Garcia[c,d]

[a] School of Psychology, Deakin University, 1 Gheringap Street, Geelong, VIC 3220, Australia
[b] Centre for Youth AOD Practice Development, Youth Support and Advocacy Service, Level 1/131 Johnston Street, Fitzroy, VIC 3065, Australia
[c] Turning Point Alcohol and Drug Centre, 54-62 Gertrude Street, Fitzroy, VIC 3065, Australia
[d] School of Psychological Sciences and Monash Institute of Cognitive and Clinical Neurosciences, Monash University, Wellington Road, Clayton, VIC 3800, Australia

ARTICLE INFO

Article history:
Received 28 August 2016
Received in revised form
14 November 2016
Accepted 28 November 2016
Available online 5 January 2017

Keywords:
Impulsivity
Cognitive bias
Substance misuse
Meta-analysis
Review

ABSTRACT

Background: Evidence indicates that substance-related cognitive biases (attentional, memory, and approach bias) contribute to the maintenance and development of substance misuse. Impulsivity has been suggested to influence how cognitive biases contribute to substance misuse, possibly by biasing incentive salience attribution processes. However, the strength and moderators of the relationship between impulsivity and substance-related cognitive biases has yet to be empirically examined.
Methods: A meta-analysis using random-effects models was completed assessing 19 studies that reported a quantitative relationship between an impulsivity measure and a substance-related cognitive bias. Two-component conceptualisation of impulsivity, impulsivity measurement type, gender, and age were assessed as moderators.
Results: A small, significant positive relationship ($r = 0.10$) was observed between impulsivity and substance-related attentional, memory, and approach biases. No moderators examined had a significant influence on this relationship.
Conclusions: Results are consistent with incentive sensitisation theories of addiction and suggests a weak synergistic relationship between impulsivity and substance-related cognitive biases. This relationship holds across different measures and components of impulsivity. Results provide some support for the viability of impulsivity and cognitive bias interaction models which may warrant further investigation of these factors in relation to predicting addiction treatment outcomes.

1. Introduction

In recent years, research has suggested that substance misuse is associated with cognitive biases (e.g., Peeters et al., 2012; Rooke et al., 2008; Thush and Wiers, 2007; Wiers et al., 2007). Cognitive biases refer to a selectivity in cognitive processing believed to be associative in nature that operates automatically with little conscious input or introspection (Stacy and Wiers, 2010). In the context of substance misuse, Stacy and Wiers (2010) propose that three classes of cognitive biases are relevant to the development and maintenance of substance misuse: attentional bias, memory bias, and approach bias. For example, evidence indicates that an automatic approach tendency (i.e., approach bias) towards cigarettes, as measured by the Approach Avoidance Task (AAT; Rinck and Becker, 2007), is present in heavy smokers, and that this bias decreases in strength following long-term abstinence (Wiers et al., 2013a,b). Similarly, substance misusers typically show an attentional bias towards substance-related cues (Field and Cox, 2008; Field et al., 2014). This attentional bias has been associated closely with subjective craving and subsequent relapse (Field et al., 2014; Marhe et al., 2013). Such findings support the view that cognitive biases may play an integral function in maintaining substance misuse. Importantly, substance-related cognitive biases may in part help to understand why individuals continue to consume substances despite considerable negative consequences (e.g., Hofmann et al., 2008; Stacy and Wiers, 2010; Wiers et al., 2007).

* Corresponding author at: School of Psychology, Deakin University, Locked Bag 20001, Geelong, VIC 3220, Australia.
E-mail address: petra.staiger@deakin.edu.au (P.K. Staiger).

http://dx.doi.org/10.1016/j.drugalcdep.2016.11.034
0376-8716/

There has been a growing interest in examining the factors and conditions that influence how cognitive biases translate into substance misuse (e.g., Farris et al., 2010; Friese and Hofmann, 2009; Wiers et al., 2010a, 2007). A variety of factors have been implicated in this link including motivation (Wiers et al., 2007), ego depletion (Christiansen et al., 2012a), acute substance effects (Korucuoglu et al., 2014), and positive and negative expectancies (Pieters et al., 2014). Prominently however, the construct of impulsivity, defined broadly as the tendency to rapidly engage in behaviours without forethought to the consequences of these actions (Evenden 1999; Moeller et al., 2001) is considered to be a key component. Impulsivity affects an individual's capacity to withhold from acting in accordance with automatic cognitive processing (i.e., cognitive biases towards substances). For example, automatic attentional bias towards substances in the environment may be difficult to 'resist' in individuals who have a tendency to act impulsively. A number of moderation studies have supported this notion (e.g., Burton et al., 2012; Lindgren et al., 2014; Wiers et al., 2010a) with general findings indicating that cognitive biases more strongly predict substance misuse among those with heightened impulsive tendencies. However, as yet, the magnitude of the associations between impulsivity and cognitive biases is unknown. Therefore, the aim of the present study is to conduct a meta-analytical review examining the strength of the associations between impulsivity and substance-related memory, attentional, and approach biases.

1.1. Impulsivity and cognitive biases

The construct of impulsivity is generally agreed to consist of a number of related, but distinct components (de Wit, 2009; Whiteside and Lynam, 2001). Generally, either a two-component model comprising rash impulsivity and reward sensitivity (Dawe et al., 2004) or a five factor model comprising urgency, (lack of) premeditation, (lack of) perseverance, sensation seeking, and positive urgency (UPPS-P; Lynam et al., 2006; Whiteside and Lynam, 2001) are proposed. Between the two, the two-component model has been posited to more closely align with neurobiological models of addiction as an imbalance between enhanced incentive salience and poor inhibitory control (see Gullo et al., 2014 for recent review). Within this framework, rash impulsivity – encompassing the inability to inhibit prepotent approach tendencies – and reward sensitivity – defined by an individual's propensity to be sensitive to, and motivated by, rewarding stimuli have been differentially related to substance misuse behaviours and presentations (Gullo et al., 2014). Specifically, reward sensitivity has been posited to associate with an amplified receptiveness to the positive reinforcement of substance misuse, contributing to earlier experimentation behaviour (Dawe and Loxton, 2004). There is evidence to support this association suggesting earlier initiation of substance misuse in individuals with elevated reward sensitivity traits (Dissabandara et al., 2014; Lyvers et al., 2009; Pardo et al., 2007). In contrast, rash impulsivity has been implicated in more severe and risky forms of substance misuse and the transition to dependence (Dawe et al., 2004). Supporting this, rash impulsivity has been found to be a more robust predictor of problematic substance misuse than reward sensitivity (Gullo et al., 2011) and riskier forms of substance misuse such as intravenous administration and escalating patterns of use (Dissabandara et al., 2014), as well as poly-substance misuse (Conway et al., 2003; Lackner et al., 2013; Loxton et al., 2008; Martinotti et al., 2009).

Our increasing recognition of the role of impulsivity to influence substance misuse has substantially contributed to better understanding of individual differences in the development and maintenance of substance misuse. However, critical questions remain regarding the interaction between impulsivity and substance-related cognitive biases. In particular, how this relationship fuels substance misuse continues to be of significant interest. Burton et al. (2012) reported that rash impulsivity (as measured by positive and negative urgency – see Cyders and Smith, 2008 for further discussion of conceptual similarities) moderated the predictive relationship between alcohol memory bias and drinking behaviour. That is, individuals high in rash impulsivity reported acting more in line with their alcohol memory bias as indicated by higher levels of drinking. These findings are consistent with previous research indicating that response inhibition moderates the relationship between alcohol memory bias and drinking behaviour in adults (Houben and Wiers, 2009) and alcohol approach bias and drinking behaviour in adolescents (Peeters et al., 2012). These findings suggest that when an individual's levels of impulsivity are high, substance-related cognitive biases more strongly predict substance misuse, possibly due to an increased governance of automatic cognitive processes in these individuals (Burton et al., 2012). Hence there is a growing interest in examining the relationship between substance-related cognitive biases and general inhibitory processes that fall within the rubric of impulsivity (Wiers et al., 2013b, 2010a).

A number of prominent theories of addiction suggest that impulsivity may influence how cognitive biases first develop and then maintain substance misuse. For example, in their incentive sensitisation theory of addiction, Robinson and Berridge (2008) propose that repeated substance misuse sensitises the neurobiological pathways associated with attributing incentive salience to rewarding stimuli. They propose that these sensitised pathways, reflected by heightened attentional bias towards substance-related cues, culminate in the core symptoms of addiction in combination with "impaired executive control over behavior" (Robinson and Berridge, 2008; p.3137), implicating impulsive characteristics in this development. Similarly, Field and Cox (2008) suggest that highly impulsive substance misusers may be more susceptible to an attentional bias towards substance-related stimuli, or that heightened attentional bias may influence an individual's impulsive tendencies. The potentially bidirectional nature of this relationship is also reflected in dual-process models of addiction. In these models, substance misuse is proposed to be informed by the relative influence of associative and reflective classes of cognitive processes (Stacy and Wiers, 2010; Wiers et al., 2007, 2010a,b). In this context, the associative system refers to the automatic, appetitive processes that are reflected by substance-related cognitive biases while the reflective system encompasses executive control capacities and an individual's ability to regulate impulses (Stacy and Wiers, 2010; Wiers et al., 2010a,b, 2007). When these systems are imbalanced, strong associative processes bypass the regulatory capabilities of the reflective system, and thus promote substance misuse (Stacy and Wiers, 2010; Wiers et al., 2010a,b, 2007). Thus, the interplay between substance-related cognitive biases and an individual's impulsive tendencies and capacity for self-regulation form the foundation of these dual-process models of addiction. Thus far, these models have largely focused on the relationship between impulsivity and attentional bias, and a recent meta-analysis of 13 studies (inclusive of 5 food-related studies) reported a small, positive relationship ($r = 0.20$) between these two constructs, providing preliminary evidence to support these models (Coskunpinar and Cyders, 2013). Coskunpinar and Cyders (2013) examined the moderating role of impulsivity measurement type where behavioural impulsivity was more strongly related to attentional bias ($r = 0.22$) than trait impulsivity ($r = 0.10$) across both substance and food studies. They also found that gender played a moderating role; that is, males reported a stronger relationship between attentional bias and impulsivity. However, their review did not include related and important cognitive biases that are part of the dual process understanding of addiction (see Stacy and Wiers, 2010). That is, evidence indicates that substance-related memory bias (e.g., Burton et al., 2012; Friese and Hofmann, 2009;