Drug and Alcohol Dependence xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

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

The role of decision-making in cannabis-related problems among young adults

Raul Gonzalez[a,b,*], Randi M. Schuster[c], Robin M. Mermelstein[d,e], Kathleen R. Diviak[e]

[a] Department of Psychology, Florida International University, Miami, 11200 SW 8th St, Miami, FL 33199, United States
[b] Center for Children and Families, Florida International University, Miami, 11200 SW 8th St, Miami, FL 33199, United States
[c] Department of Psychiatry, Massachusetts General Hospital, Boston, 55 Fruit Street, Boston, MA 02114, United States
[d] Department of Psychology, University of Illinois at Chicago, Chicago, 1200 W Harrison St, Chicago, IL 60607, United States
[e] Institute for Health Research and Policy, University of Illinois at Chicago, Chicago, 1747 W Roosevelt Rd, Chicago, IL 60608, United States

ARTICLE INFO

Article history:
Received 2 March 2015
Received in revised form 6 May 2015
Accepted 25 June 2015
Available online xxx

Keywords:
Cannabis
Decision-making
Addiction

ABSTRACT

Background: Deficits in decision-making and episodic memory are often reported among heavy cannabis users, yet little is known on how they influence negative consequences from cannabis use. Individual differences in decision-making may explain, in part, why some individuals experience significant problems from their cannabis use whereas others do not. We hypothesized that poor decision-making would moderate relationships between amount of cannabis use and problems from cannabis use whereas episodic memory performance would not.
Method: Young adult cannabis users ($n = 52$) with cannabis as their drug of choice and with minimal comorbidities completed semi-structured interviews, self-report questionnaires, and measures of neurocognitive functioning, with decision-making accessed via the Iowa Gambling Task (IGT), episodic memory via the Hopkins Verbal Learning Test – Revised (HVLT) and problems from cannabis use with the Marijuana Problems Scale.
Results: Strong relationships were observed between amount of cannabis use (lifetime, 12-month, and 30-day) and problems reported from use, but only among participants with low (impaired) decision-making ($R^2 = .39$ to $.51$; $p < .01$). No significant relationships were observed among those with better (low average to high average) decision-making performance ($p > .05$). In contrast, episodic memory performance was not a significant moderator of the relationship between amount of cannabis use and cannabis problems ($p > .05$).
Conclusions: Cannabis users with poor decision-making may be at greater risk for experiencing significant negative consequences from their cannabis use. Our results lend further support to emerging evidence of decision-making as a risk factor for addiction and extend these findings to cannabis users.

1. Introduction

Deficits in neurocognitive functioning are a well-documented negative consequence of frequent cannabis use (Gonzalez, 2007; Grant et al., 2003; Lisdahl et al., 2014; Pope et al., 2001; Schreiner and Dunn, 2012; Solowij et al., 2002). Meta-analyses on studies of non-intoxicated cannabis users reveal deficits in learning, recall, executive functions, attention, motor abilities, and language (Grant et al., 2003; Schreiner and Dunn, 2012), with deficits in episodic memory (i.e., memory for personally experienced information, as opposed to facts; Tulving, 1984) being one of the most consistently reported (Gonzalez, 2007; Ranganathan and D'Souza, 2006; Solowij and Battisti, 2008). Although several studies document that recovery of most neurocognitive functions may occur after about 1 month of abstinence (Fried et al., 2005; Hanson et al., 2010; Pope et al., 2001; Schreiner and Dunn, 2012), others have shown that some deficits (e.g., attention and decision-making) persist, especially among very heavy users, those using during early adolescence, and individuals with persistent cannabis use disorders (Bolla et al., 2002, 2005; Hanson et al., 2010; Meier et al., 2012; Pope et al., 2003). However, as with most drugs of abuse, the majority of cannabis users (approximately 91%) do not go on to develop a cannabis use disorder (Anthony et al., 1994; Lopez-Quintero et al., 2011). Although myriad factors may make some cannabis users more vulnerable to cannabis use disorders and to experience more problems from their cannabis use (Kirisci et al., 2013; von Sydow et al., 2002), the role of neurocognitive performance has been

* Corresponding author at: Florida International University, 11200 SW 8th St, AHC-4, Room 461, Miami, FL 33199, United States..
E-mail address: raul.gonzalezjr@fiu.edu (R. Gonzalez).

http://dx.doi.org/10.1016/j.drugalcdep.2015.06.046
0376-8716/

relatively understudied, as it is typically examined as a consequence of use in studies of cannabis and neurocognition. A notable exception is a recent study by Day et al. (2013) that reported poorer "working memory" (as assessed by the Trail-Making Test B) was associated with more problems from cannabis use among an adult sample of frequent cannabis users.

Decision-making is a neurocognitive construct that may play an important role in the magnitude of problems experienced from cannabis use. It has been defined in numerous ways (Bechara et al., 2001; Paulus et al., 2003), but essentially refers to making the most advantageous choice under uncertain outcomes that may result in reward or punishment. The Iowa Gambling Task (IGT) is one of the most commonly used measures of decision-making among many available (Monterosso et al., 2001) and requires participants to make choices under conditions of uncertain risk with the goal of obtaining the most advantageous outcome over 100 trials. A seemingly advantageous choice on one trial may be a losing strategy over many trials. Poor overall performance on this task is thought to reflect a preference for immediate rewards even if they are at the expense of longer-term negative outcomes – sometimes referred to as "myopia for the future," which is observed among patients with lesions affecting the orbitofrontal cortex (OFC; Bechara et al., 1994, 2002). This mirrors to some extent the behavior of individuals with cannabis use disorders, who by definition continue to use cannabis despite experiencing significant negative consequences. Not surprisingly, individuals with various substance use disorders perform poorly on measures of decision-making, including those with alcohol, cocaine, and methamphetamine addiction (e.g., Barry and Petry, 2008; Gonzalez et al., 2007; Grant et al., 2000; van der Plas et al., 2009; Verdejo-Garcia et al., 2007). Similarly, poorer performance on the IGT has also been reported among cannabis users (Bolla et al., 2002, 2005; Fernandez-Serrano et al., 2009; Hermann et al., 2009; Lamers et al., 2006; Verdejo-Garcia et al., 2007; Whitlow et al., 2004). Oftentimes, this is thought to reflect adverse effects of the drug on brain structure, function, or development.

However, emerging evidence lends support to decision-making as an important predictor and moderator in substance use outcomes. For example, poor decision-making performance has been associated with attrition in a weight-management program (Koritzky et al., 2014) and relapse for cocaine (Verdejo-Garcia et al., 2014), methamphetamine (Paulus et al., 2005), alcohol (Bowden-Jones et al., 2005), and opiates (Passetti et al., 2008). With regards to problems from cannabis use, neuroimaging studies have revealed relationships between OFC gray matter volume and more self-reported problems from cannabis (Filbey et al., 2014) and OFC activation with cannabis use relapse (De Bellis et al., 2013), further substantiating the potential role of decision-making deficits in the problems experienced from cannabis use. We recently reported no significant differences between cannabis users and non-users on several measures of inhibitory control (including decision-making), despite finding deficits in episodic memory; (Gonzalez et al., 2012). Despite the lack of differences between groups on measures of decision-making and inhibitory control, we found that poorer decision-making performance alone was significantly associated with more DSM-IV symptoms of cannabis use disorder. In a subsequent manuscript with the same sample, decision-making was found to moderate the relationship between amount of cannabis use and engagement in risky sexual behaviors, with greater cannabis use being associated with more risky sexual behaviors, but only among participants with poorer decision-making (Schuster et al., 2012).

In the current study, we set out to examine in more detail how decision-making influences the problems that individuals report experiencing from their cannabis use by using a more fine-grained and well-established measure of cannabis use problems: the Marijuana Problems Scale (Stephens et al., 2000), as well as specifically looking at amount of use across three different time frames (30-day, 12-month, and lifetime). The Marijuana Problems Scale allows for rating the severity of numerous problems that may be experienced by cannabis users as a consequence of their cannabis use. Based on our prior findings, we sought to test the role of decision-making as a potential moderator of the relationship between amount of cannabis use and problems experienced from cannabis use in a sample of young adult cannabis users who identified cannabis as their drug of choice. Contrary to the fairly consistent finding of acute and non-acute cannabis use on episodic-memory that some have reported to resolve with abstinence (noted above), studies on cannabis effects on decision-making have been less consistent, oftentimes showing no acute effects (reviewed in Crean et al. 2011) and a lack of recovery with abstinence (e.g., Bolla et al., 2002, 2005; Crean et al., 2011). Therefore, for comparison and to test for a simple dissociation, in the present study we also examined whether episodic memory performance also served as a moderator of cannabis use and problems from cannabis use. We hypothesized that poorer decision-making and more cannabis use would be related to more cannabis-related problems as measured by the Marijuana Problems Scale (Stephens et al., 2000). More importantly, we anticipated that decision-making performance would moderate the relationship between amount of cannabis use and problems experienced from cannabis use, such that the association between amount of cannabis use and problems from use would be strongest for those with poorer decision-making. We hypothesized that similar relationships would not be observed with measures of episodic memory. Finally, we explored if the moderating effects of decision-making were more relevant for measures of current (30 day) or more distal (12 month and lifetime cumulative use) cannabis use.

2. Material and methods

2.1. Participants

Participants were a subset ($n = 52$) of cannabis users from a larger study on inhibitory control and cannabis use among young adults (K23DA023560; PI: Gonzalez) who completed the Marijuana Problems Scale. The Marijuana Problems Scale was introduced after the onset of the larger study and the current sample consists of all eligible participants from the larger study who completed the Marijuana Problems Scale. Participants were recruited from the Chicago area through word-of-mouth and printed flyers placed throughout the community. A small subset was recruited and enrolled from a longitudinal study of trajectories to nicotine dependence (P01 CA098262; PI: Mermelstein). The investigation was approved by the Institutional Review Board of the University of Illinois at Chicago and all participants provided informed consent.

Detailed eligibility criteria are presented in a prior manuscript (Gonzalez et al., 2012). Briefly, participants were screened via telephone, had more than 8 years of education, estimated IQ greater than 75, and no significant neurological, mental health, or developmental problems. All participants used cannabis in the 45 days prior to their evaluation, more than 200 times during their lifetime, at least four times per week during peak use, and identified cannabis as their drug of choice. Those evidencing alcohol dependence or recent heavy drinking were excluded, as were those with any other substance use disorder (with the exception of nicotine or caffeine), or history of using other substances more than 10 times in their lifetime or during the 30 days prior to their evaluation (alcohol, nicotine, and hallucinogens notwithstanding). Lifetime frequency of hallucinogen use ranged from 4 to 24 times (median = 5, IQR = 4, 7.25), with no participant meeting criteria for a hallucinogen use disorder and none reporting use less than 45 days since their study

Please cite this article in press as: Gonzalez, R., et al., The role of decision-making in cannabis-related problems among young adults. Drug Alcohol Depend. (2015), http://dx.doi.org/10.1016/j.drugalcdep.2015.06.046