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Cannabis use, schizotypy, and negative priming

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ABSTRACT

The present study examined the effects of frequency of cannabis use, schizotypy, and age on cognitive control, as measured using a location-based negative priming task in a sample of 124 Australians aged 15–24 who had ever used cannabis. This study found that the schizotypy dimension of Impulsive Nonconformity had a significant effect on negative priming such that participants with higher scores on this dimension showed reduced negative priming. Also, higher levels of psychological distress were associated with greater negative priming. Finally, there was a significant age by cannabis use interaction indicating that younger, frequent users of cannabis may be more susceptible to its effects on cognitive control and perhaps at greater risk of developing a disorder on the psychosis dimension.

1. Introduction

There is a well-established association between cannabis use and psychosis (for a review, see Wilkinson et al. (2014)). Longitudinal studies indicate that cannabis use may be a risk factor for the development of symptoms of psychosis (Henquet et al., 2004). Also, studies have shown that people with schizophrenia who used cannabis in adolescence have an earlier age of onset of psychotic illness (Large et al., 2011), with continued use of cannabis following the onset of psychosis resulting in a more severe course of psychotic illness and poorer treatment outcomes (Clausen et al., 2013). Furthermore, administration of tetrahydrocannabinol (THC) to healthy participants has been shown to temporarily induce positive (Barkus et al., 2011) and negative psychosis-like symptoms (Morrison and Stone, 2011).

People who use cannabis regularly display similar cognitive impairments to those typically found in patients with schizophrenia, including deficits in cognitive control (for a review, see Solowij and Michie (2007)). Cognitive control refers to the ability to suppress/inhibit irrelevant or conflicting information (interference suppression) and/or prepotent responses (response inhibition). Deficits in suppressing irrelevant information have long been recognised as a key feature of schizophrenia (McGhie and Chapman, 1961) and have been theorised to underlie core schizophrenia symptoms such as hallucinations and other positive symptoms (Frith, 1979; Kapur, 2003; Howes and Kapur, 2009; Van Os, 2009). However, studies showing that cognitive control deficits are present in first-degree relatives of people with schizophrenia independently of subclinical symptoms (Snitz et al., 2006) suggest that cognitive control deficits may be better understood as reflecting risk for psychotic disorders rather than directly related to the symptoms themselves.

Animal and human research suggests that adolescent exposure to cannabis carries a particularly high risk for psychosis-related outcomes and cognitive impairment (Ehrenreich et al., 1999; Arseneault et al., 2002; Schneider and Koch, 2003). Findings of heightened risk associated with adolescent cannabis use, coupled with research pointing to a role of the endocannabinoid system in regulating neurodevelopmental processes, have led to speculation that adolescent cannabis use may disrupt the normal course of neurodevelopmental processes and result in changes in brain functioning similar to those associated with risk for psychosis (Viveros et al., 2012) or to psychosis itself (Bossong and Niesink, 2010).

The negative priming procedure is a cognitive task that was designed specifically to examine cognitive control (Tipper, 1985; Neill et al., 1995; de Fockert et al., 2010). In this context, cognitive control refers to the use of inhibitory processes to suppress attention and/or responses to distracting stimuli in order to focus cognitive resources on *target* stimuli that are the focus of current goals. In a typical location-based negative priming task,

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participants are repeatedly asked to locate a target stimulus while ignoring a distractor stimulus. In order to perform this task successfully, participants must apply cognitive control in order to inhibit attention and/or responses to the distractor. It is typically found that responses to the target are slower when this target appears in a location that was occupied by the distractor in the previous display. This is referred to as the negative priming effect, and it is taken to suggest that inhibition of the mental representation of the distractor location (or the response to that location) carries over from the previous display (Tipper et al., 1994; Tipper, 2001). On this account, the stronger a person's ability or tendency to inhibit distracting information, the stronger the negative priming effect will be. Importantly, and consistent with the suggestion that psychosis is associated with a dysfunction in cognitive control, location-based negative priming is reduced in patients with schizophrenia (e.g., Macqueen et al., 2003) as well as first-degree relatives and people with elevated schizotypy (Park et al., 1996), a personality construct that at high levels is thought to indicate a predisposition for psychotic disorders (Nelson et al., 2013).

A recent study has found that current cannabis users also display reduced location-based negative priming compared to past users and controls (Skosnik et al., 2001). In this study, however, frequency of cannabis use was not found to be associated with negative priming among regular users. The authors suggested that this might have been due to variability of THC potency across different cannabis strains, which may have masked frequency-related effects. Alternatively, frequency of use may not be related to negative priming after all and other cannabis-related variables, such as age of first cannabis use, may be better predictors. Although, as noted above, cannabis use in early adolescence carries an especially high risk for cognitive impairment and psychosis-related outcomes, no study to date has explored the effects of age of first use on location-based negative priming in regular cannabis users. Another factor that may have contributed to the lack of an association between frequency of use and negative priming in regular cannabis users may be that the impairments in negative priming found in that group were not related to cannabis use directly but rather resulted from their elevated schizotypy (which was noted by Skosnik et al., 2001). As stated above, high levels of schizotypy are themselves considered a risk factor for psychosis and related to deficits in location-based negative priming. Thus, the finding of reduced negative priming among cannabis users by Skosnik et al. (2001) may simply have been a reflection of higher schizotypy among users.

In order to address these gaps in the literature, the current study used a sample of young adults (aged 15–24) to examine the effects of cannabis use and schizotypy on location-based negative priming, and explored whether the effects of cannabis use on negative priming vary according to age. Understanding how cannabis use interacts with age to influence negative priming in adolescents and young adults may provide a greater understanding of the effects of cannabis on neurodevelopmental processes associated with an increased risk of psychosis and related disorders.

2. Method

2.1. Participants

Participants were recruited in Australia via advertisements in national newspapers, websites, community notice boards, and email update lists. Inclusion criteria included being aged between 14 and 24 years and fluent in English. Exclusion criteria included (i) past head injury or neurological disorders, (ii) having ever received a diagnosis of schizophrenia or schizoaffective disorder, and (iii) having a first-degree relative with schizophrenia or schizoaffective disorder. The final sample included 133 participants.

2.2. Procedures

The experiment was run over the internet; all measures were implemented using *Inquisit* (2012), a software program designed to run experiments and surveys online. Interested participants were emailed information about the study, a screening form, and a consent form. Eligible participants who consented to take part were sent a link via email to complete the assessment. Upon completion of the assessment, participants were emailed a $20 online electronics store voucher. The UNSW Human Research Ethics Committee approved all aspects of this study.

2.3. Measures

2.3.1. Demographic and substance use information

Participants completed a questionnaire asking about demographic information including gender, age, and family history of psychosis-related disorders. The questionnaire asked participants whether they had ever used tobacco, alcohol, cannabis, and other illicit drugs and if so, at what age was their first use. As age of first use can be obtained only from participants who have ever used cannabis and is a variable that we wished to control for, only participants who had ever used cannabis were included in this study.

Participants were asked whether they had used cannabis in the past six months and if so, to what extent they had used it: Less than once a month; About once a month; Once a week or more; or Daily. This was used to categorise participants into two groups, those who used cannabis once a week or more often (frequent users, $n=38$) versus those who used cannabis less than once a week, including no use, in the past six months (occasional users, $n=95$). For participants who reported past month alcohol and tobacco use, further measures were taken using the relevant items from the brief treatment outcome measure (BTOM; Lawrinson et al., 2005), which assess the number of days of use in the last month, quantity of use per typical day of use, and method of use. Lastly, participants were asked when they last used cannabis and their responses categorised according to whether they last used cannabis in the past 24 h or more than 24 h ago.

2.3.2. Psychological distress

Participants completed the brief Depression Anxiety Stress Scales (DASS-21; Lovibond and Lovibond, 1995), which contains 21 items assessing depression, anxiety, and stress/tension symptoms. Due to high correlations among the three sub-scales, total scores were used to control for overall psychological distress.

2.3.3. Schizotypy

An adapted version of the short form of the Oxford-Liverpool Inventory of Feeling and Experiences (OLIFE; Mason et al., 2005) was used. This measure comprises four subscales: Unusual Experiences, Introvertive Anhedonia, Cognitive Disorganisation, and Impulsive Non-conformity. The Unusual Experiences scale measures deviant perceptual and cognitive experiences related to the positive symptoms of schizophrenia (e.g., “Have you ever thought that you had special, almost magical powers?”), and is often referred to as positive schizotypy. The Introvertive Anhedonia scale assesses the inability to experience pleasure, which relates to the negative symptoms of schizophrenia (e.g., “Do you like mixing with people?”). Introvertive Anhedonia is often referred to as negative schizotypy. Cognitive Disorganisation items relate to

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