Executive attention impairment in adolescents with schizophrenia who have used cannabis

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Objective: Repeated exposure to cannabis in nonpsychotic adolescents is associated with impairments in executive control of attention, similar to those observed in young adults with first-episode schizophrenia. To assess the impact of recurrent exposure to cannabis on cognitive function, this study characterized attention performance in both nonpsychotic adolescents and adolescents with early-onset schizophrenia (EOS).

Method: The Attention Network Test, a standard procedure that estimates the functional state of neural networks controlling the efficiency of three different attentional behaviors (alerting, orienting, and executive attention), was administered to four groups of participants: (1) adolescents with EOS and comorbid cannabis use disorder (EOS + CUD; n = 18), (2) “Pure” schizophrenia (EOS; n = 34), (3) “Pure” cannabis use disorder (CUD; n = 29), and (4) Healthy controls (HC; n = 53). Task performance was examined with a 2 × 2 design (EOS + versus EOS − and CUD + versus CUD −) using multivariate analysis of covariance. Correlative analyses were conducted between executive attention performance and measures of surface area in the right anterior cingulate cortex.

Results: A significant EOS × CUD interaction was observed. In the executive attention network, adolescents with EOS + CUD showed reduced efficiency relative to adolescents with pure EOS, whereas no group differences were found between adolescents with pure CUD and HC. Less efficient executive attention was significantly associated with smaller surface area in the right caudal anterior cingulate cortex in EOS + CUD.

Conclusions: These preliminary data suggest that the presence of CUD has a moderating effect on attentional performance in adolescents with schizophrenia compared to nonpsychotic adolescents. These deficits could have a role in difficulties with self-regulation and predisposition to substance misuse in this patient group. The anatomic substrate of this cognitive deficit may be related to surface area in the right caudal anterior cingulate cortex.

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1. Introduction

Attention refers to both preparedness for and selection of certain aspects of our physical environment or some ideas in our mind that are stored in our memory (Raz and Buhle, 2006). Current models show that attention is not a unitary function but the result of three different attentional mechanisms used. From around age 4, an executive attention network gradually takes over the alerting and orienting systems and becomes the dominant factor in cognitive control (Rothbart et al., 2011) as children develop the ability to use rules, strategies, and plans to guide their behavior (Berger et al., 2007). In parallel, improvement in cognitive control begins at age 4 with a steep developmental trajectory that gradually decreases in slope and plateaus at around age 14 to 15 years. In general, self-regulation and executive attention continue to develop throughout childhood and well into adolescence (Fjell et al., 2012).

Cannabis use disorder (CUD) is highly prevalent among adolescents with early-onset schizophrenia (EOS) (Kumra et al., 2012), but the basis of this comorbidity remains unclear. It is possible that attentional impairment is a common risk factor that predisposes adolescents to both disorders. To understand the basis of the comorbidity between CUD and EOS, this study characterized attention performance in both nonpsychotic adolescents and adolescents with EOS using the ANT (Fan et al., 2002). Applying the ANT to patients with schizophrenia, Wang and colleagues found a marked deficit in the executive control network and a less pronounced deficit in the orienting network (Wang et al., 2005). Using the ANT, impairments in executive attention have been

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described in both nonpsychotic adolescents with CUD (Abdullaev et al., 2010) and in adults with schizophrenia alone (Wang et al., 2005; Breton et al., 2011; Orellana et al., 2012). To our knowledge, attention networks in patients suffering from the schizophrenia–cannabis comorbidity have not been evaluated with the ANT. Based on previous reports (Wang et al., 2005; Abdullaev et al., 2010; Orellana et al., 2012), we hypothesized that the presence of CUD might moderate the association between impairments in executive attention and EOS. Examining executive attention deficits in both healthy adolescents and adolescents with EOS is an important topic of inquiry because these impairments could lead to difficulties in exerting control over thoughts, feelings, and actions, and predispose them to cannabis misuse.

As an exploratory aim, we examined whether performance on the executive attention component of the ANT was associated with surface area in the anterior cingulate cortex, the central structure of the executive attention network (Fair et al., 2009; Posner, 2012). Recently, a large multicenter study showed that surface area in the right anterior cingulate cortex, the central structure of the executive component of the ANT was associated with surface area in patients suffering from the schizophrenia-cannabis comorbidity (Wang et al., 2005; Abdullaev et al., 2010; Orellana et al., 2012). To our knowledge, attention networks in patients with schizophrenia-cannabis comorbidity have not been evaluated with the ANT. Based on previous reports (Wang et al., 2005; Abdullaev et al., 2010; Orellana et al., 2012), we hypothesized that the presence of CUD might moderate the association between impairments in executive attention and EOS. Examining executive attention deficits in both healthy adolescents and adolescents with EOS is an important topic of inquiry because these impairments could lead to difficulties in exerting control over thoughts, feelings, and actions, and predispose them to cannabis misuse.

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