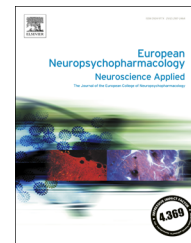




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Exploring personality traits related to dopamine D_{2/3} receptor availability in striatal subregions of humans

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Abstract

While several studies have examined how particular personality traits are related to dopamine D_{2/3} receptor (D_{2/3}R) availability in the striatum of humans, few studies have reported how multiple traits measured in the same persons are differentially related to D_{2/3}R availability in different striatal sub-regions. We examined how personality traits measured with the Karolinska Scales of Personality are related to striatal D_{2/3}R availability measured with [¹¹C]-raclopride in 30 healthy humans. Based on previous the literature, five personality traits were hypothesized to be most likely related to D_{2/3}R availability: impulsiveness, monotony avoidance, detachment, social desirability, and socialization. We found self-reported impulsiveness was negatively correlated with D_{2/3}R availability in the ventral striatum and globus pallidus. After controlling for age and gender, monotony avoidance was also negatively correlated with D_{2/3}R availability in the ventral striatum and globus pallidus. Socialization was positively correlated with D_{2/3}R availability in the ventral striatum and putamen. After controlling for age and gender, the relationship between socialization and D_{2/3}R availability in these regions survived correction for multiple comparisons (*p*-threshold=.003). Thus, within the same persons,

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different personality traits are differentially related to *in vivo* D_{2/3}R availability in different striatal sub-regions.

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1. Introduction

Many attempts have been made to link personality traits - self-reported enduring patterns of perceiving, relating to, and thinking about the environment and oneself (Engler, 2013) - with the brain dopamine (DA) D_{2/3} receptor (D_{2/3}R) system (Cumming, 2009). Using positron emission tomography (PET), several studies have examined the relationship between striatal D_{2/3}R availability in healthy humans and the personality traits of impulsivity (Buckholtz et al., 2010; Kim et al., 2014; Lee et al., 2009; Oswald et al., 2007; Reeves et al., 2012; Rosa-Neto et al., 2005; Weiland et al., 2014), novelty seeking/sensation seeking (Boileau et al., 2006; Gjedde et al., 2010; Leyton et al., 2002), social attachment (Breier et al., 1998; Farde et al., 1997), and social desirability (Cervenka et al., 2010; Egerton et al., 2010; Reeves et al., 2007). However, many of these studies have not examined the relationship between these different traits and D_{2/3}R availability within the same persons; rather they have often focused on a single trait. Moreover, not all studies have differentiated sub-regions of the striatum, for example the ventral striatum (VS) and globus pallidus (GP).

We examined in 30 healthy persons the relationship between personality traits measured with the Karolinska Scales of Personality (KSP) and DA D_{2/3}R availability in multiple sub-regions of the striatum using [¹¹C]-raclopride. Our *a priori* focus was on those traits captured by the KSP which are thought to be related to DA functioning in the striatum: impulsiveness, monotony avoidance, detachment, social desirability, and socialization. We focused our *a priori* personality traits based on those studies which used radioligands for D_{2/3}R and found relationships between striatal D_{2/3}R availability and personality traits. However, other radiotracers relevant to the DA system have been employed. For example, several studies have looked at DA synthesis capacity (Laakso et al., 2003; Lawrence and Brooks, 2014; Menza et al., 1995; Schluter et al., 2013) and DA transporter availability (Laakso et al., 2000), in relation to personality traits. It should be emphasized that although baseline striatal D_{2/3}R availability and striatal DA synthesis capacity are related (Ito et al., 2011), they are also distinct; the former being affected by not just endogenous DA levels, but also the total density and affinity of receptors (Gunn et al., 2015). For example, using more direct estimates of endogenous DA, it has been reported that only 16% of the variance in baseline [¹¹C]-raclopride binding in the striatum can be accounted for by endogenous DA ($r(31) = -.40, p = .02$) (Kegeles et al., 2014). Finally, it is noteworthy that studies have observed relationships between personality traits and baseline extra-striatal D_{2/3}R availability (Buckholtz et al., 2010; Suhara et al., 2001). To our knowledge, this study is the first to report how all these traits, measured with the KSP, relate to D_{2/3}R availability with [¹¹C]-raclopride in the same persons. Moreover, to our knowledge this study employs to date the

largest sample of [¹¹C]-raclopride scans investigating the relationship between baseline D_{2/3}R availability and personality traits. This investigation lends further support to the hypothesis that different personality traits are differentially related to the functioning of the DA D_{2/3}R system in different striatal regions in humans.

2. Experimental procedures

2.1. Participants

This analysis included PET scans previously collected from healthy persons from various studies conducted by our lab (Caravaggio et al., 2015; Graff-Guerrero et al., 2009, 2008). To decrease potential noise, in instances where subjects were scanned with multiple radiotracers besides [¹¹C]-raclopride, only data from persons scanned with [¹¹C]-raclopride first were used. Participants were right-handed non-smoking adults free of any major medical or psychiatric disorders as determined by clinical interview, the Mini International Neuropsychiatric Interview (Lecrubier et al., 1997), basic laboratory tests, and electrocardiography. At inclusion and before the PET scan participants were required to have a negative urine screen for drugs of abuse and/or pregnancy. All participants provided written informed consent. This study was approved by the Research Ethics Board of the Centre for Addiction and Mental Health (CAMH), Toronto.

2.2. Karolinska Scales of Personality

On the day of the PET scan, all participants completed the KSP self-report questionnaire (Schalling et al., 1987). The KSP comprises 15 personality subscales which are scored on a four point Likert scale (1=does not apply, 4=applies completely). Based on previous research, we expected measurements from 5 of the subscales to be potentially related to baseline D_{2/3}R availability measured with [¹¹C]-raclopride: impulsiveness, monotony avoidance, detachment, social desirability, and socialization. Impulsiveness measures the degree to which people endorse acting on “the spur of the moment” (i.e. non-planning impulsivity) (Ortet et al., 2002). Monotony avoidance assesses the desire to avoid routine and seek change (Ortet et al., 2002). Detachment measures the degree to which people are involved or withdrawn from others (Farde et al., 1997; Ortet et al., 2002). Social desirability assesses the degree to which people are socially comforting, helpful, or “fake good” (Cervenka et al., 2010; Ortet et al., 2002). Socialization captures the degree to which participants had positive childhood experiences and satisfaction with current life events (Ortet et al., 2002).

2.3. PET imaging

The radiosynthesis of [¹¹C]-raclopride and the acquisition of PET images have been described in detail elsewhere (Graff-Guerrero et al., 2008; Wilson et al., 2000). Briefly, images were acquired using a high resolution head-dedicated PET camera system (CPS-HRRT; Siemens Molecular Imaging, USA), which measures radioactivity in 207 brain slices with a thickness of 1.2 mm each. The in-plane resolution was ~2.8 mm full-width at half-maximum (FWHM).

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