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Olfactory identification deficit and its relationship with hedonic traits in patients with first-episode schizophrenia and individuals with schizotypy

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ABSTRACT

Objective: Olfactory identification impairments have been consistently found in schizophrenia patients. However, few previous studies have investigated this in first-episode patients. There are also inconsistent findings regarding olfactory identification ability in psychometrically-defined schizotypy individuals. In this study, we directly compared the olfactory identification ability of first-episode schizophrenia patients with schizotypy individuals. The relationship between olfactory identification impairments and hedonic traits was also examined.

Methods: Thirty-five first-episode schizophrenia patients, 40 schizotypy individuals as defined by the Chapman's Anhedonia Scales and 40 demographically matched controls were recruited. The University of Pennsylvania Smell Identification Test was administered. Hedonic capacity was assessed using the Temporal Experience of Pleasure Scale (TEPS).

Results: The results showed that both the schizophrenia and schizotypy groups showed poorer olfactory identification ability than controls, and the impairment was significantly correlated with reduced pleasure experiences.

Conclusion: Our findings support olfactory identification impairment as a trait marker for schizophrenia.

1. Introduction

The olfactory neural circuitry is a unique system closely connected to the orbitofrontal and limbic regions, overlapping with brain regions involved in schizophrenia (Moberg et al., 1999). Recent meta-analytic studies have consistently concluded that schizophrenia patients are impaired in olfactory identification ability (Cohen et al., 2012; Moberg et al., 2014). Moreover, unaffected first-degree relatives of schizophrenia patients have also been found to have olfactory identification impairments (Kamath et al., 2014). In a twin study, Ugur et al. (2005) demonstrated that unaffected, monozygotic co-twins of schizophrenia patients exhibited a partial impairment of olfactory identification suggesting a genetic basis for olfactory dysfunction in schizophrenia. Taken together, these lines of evidence suggest that olfactory identification impairments may be a putative biomarker of schizophrenia.

Although in a recent meta-analysis Moberg et al. (2014) reported that the effect size of olfactory identification impairments in schizophrenia patients did not vary significantly with negative symptomatology, there is emerging evidence suggesting that schizophrenia patients with the deficit syndrome have poorer olfactory identification ability than their non-deficit syndrome counterparts (Brewer et al., 1996; Malaspina and Coleman, 2003; Malaspina et al., 2002; Strauss et al., 2010). Several studies have also reported that olfactory impairments in schizophrenia patients were associated with poor self-care (Brewer et al., 1996) and diminished social drive (Malaspina and Coleman, 2003). In another study, Strauss et al. (2010) suggested that schizophrenia patients with olfactory identification impairment showed reduced hedonic capacity, suggesting dysfunction of the orbitofrontal area.

Meehl (1962, 1990) conceptualized schizotype as an inherited neural integrative defect, and schizophrenia as the decompensated end-

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stage of the interaction between this inherited defect and the environment. Schizotypy is a set of behavioural characteristics manifesting the nature of schizotype, and resembles the clinical symptoms of schizophrenia, albeit in an attenuated form. In light of this conceptualization and recent meta-analytic findings (Cohen et al., 2012; Moberg et al., 2014), it is reasonable to hypothesize that individuals with schizotypy may also be impaired in olfactory identification. To date, several studies have examined olfactory identification in individuals with psychometrically-defined schizotypy (Auster et al., 2014; Kamath and Bedwell, 2008; Park and Schoppe, 1997; Zou et al., 2015), but results have been inconsistent. Whereas Park and Schoppe (1997) reported that schizotypy individuals were impaired in olfactory identification, the other studies did not find any association between schizotypy features and olfactory identification ability (Auster et al., 2014; Kamath and Bedwell, 2008; Zou et al., 2015). Notably, all these studies utilized the Schizotypal Personality Questionnaire (SPQ: Raine, 1991) to identify DSM-IV schizotypal personality disorder (SPD), as a proxy of schizotypy. However, Lenzenweger (2015) suggested that SPD might not be a good construct to represent schizotypy. A refined method of case ascertainment for psychometrically-defined schizotypy is needed. Moreover, no previous study on olfaction has directly compared schizotypy individuals with schizophrenia patients, and few studies have examined the relationship between olfaction and hedonic traits in schizotypy individuals (Zou et al., 2015).

This study attempted to address the limitations of previous studies by robustly defining schizotypy individuals using the Chapman's Anhedonia Scales (Barrantes-Vidal et al., 2010; Chan et al., 2016; Chan et al., 2015; Wang et al., 2012), and directly comparing schizotypy individuals with schizophrenia patients and controls. We also examined the correlation between olfactory identification ability and hedonic traits, using a measure capturing the wanting and liking facets of hedonic capacity (Berridge and Robinson, 1998). We hypothesized that schizotypy individuals would be impaired in olfactory identification, compared with controls; but the impairments would be milder than schizophrenia patients. In addition, previous studies found that olfactory identification deficits were associated with anhedonia in schizophrenia patients (Ishizuka et al., 2010) and individuals with schizotypy (Zou et al., 2015). Therefore, we also hypothesized that olfactory identification impairments in schizotypy individuals would be correlated negatively with the ability to experience pleasure in everyday life.

2. Methods

2.1. Participants

Thirty-five first-episode schizophrenia patients were recruited from the Second Xiangya Hospital of the Central South University in Changsha, Hunan, China. The inclusion criteria of schizophrenia participants were (1) age 17–30, (2) education ≥ 9 years, and (3) duration of illness ≤ 3 years. The exclusion criteria were (1) a lifetime history of substance abuse, (2) brain injury, (3) other neuropsychiatric disorders, (4) influenza or common cold in the past one week, and (5) a history of nose and throat diseases. All of them met the diagnostic criteria for schizophrenia according to the DSM–IV (APA, 2000), and diagnoses were ascertained by qualified psychiatrists using semi-structured interviews (First et al., 1997). Clinical symptoms were assessed by trained psychiatrists using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987).

Individuals with schizotypy and healthy controls were identified from a large pool of 2847 college students recruited from the North China Electric Power University, Beijing, China, based on their ratings on the Chapman Social Anhedonia Scale (CSAS) and the Chapman Physical Anhedonia Scale (CPAS) (Chan et al., 2012b; Chapman et al., 1976; Wang et al., 2012). We recruited 40 participants with schizotypy who scored ≥18 on the CSAS, and 40 healthy controls who scored ≤10 and ≤15 on the CSAS and the CPAS respectively. The same exclusion criteria applied to the schizotypy and control groups. Except for 2 participants with schizotypy, all of the participants in the two groups were free from family history of neuropsychiatric disorders.

This study was approved by the Ethics Committees of the Institute of Psychology, the Chinese Academy of Sciences, and the Second Xiangya Hospital of Central South University in Changsha, Hunan, China. Written informed consents were obtained from all participants.

2.2. Olfactory identification ability

The University of Pennsylvania Smell Identification Test (UPSIT; Doty et al., 1984) was used to assess participants' olfactory identification abilities. The UPSIT consists of four booklets, and has a total of 40 test items. Each item contains a “scratch and sniff” odourant strip, embedding a super-threshold odourant in formaldehyde polymer microcapsules. The examiner scratched the strip with a pencil tip in a standardized manner, and then presented the strips birhinally to the participants. Each item of the booklets had four multiple choice answers (e.g., “chocolate, pizza, peanut, or banana”), but only one of them was the correct type of odour presented in the strip. Participants were required to make a forced-choice response. A correct answer to an item of the UPSIT would yield 1 mark. The total UPSIT score therefore ranged from 0 to 40, with higher scores indicating better olfactory identification ability.

2.3. Self-report hedonic traits

The Temporal Experience of Pleasure Scale (TEPS) (Chan et al., 2012a; Gard et al., 2006) is a 20-item self-report questionnaire, which has been validated in the Chinese population (Chan et al., 2012a), and applied in schizophrenia patients (Li et al., 2015; Lui et al., 2015) and schizotypy individuals (Li et al., 2015) in previous studies. Contrary to the original version of the TEPS (Gard et al., 2006), the Chinese version has been found to have a four-factor structure (Chan et al., 2012a), comprising the abstract anticipatory, the contextual anticipatory, the abstract consummatory, and the contextual consummatory subscales. Participants were asked to report their experiences of pleasure in everyday life, based on the 6-point Likert scale (from 1 = very false for me to 6 = very true for me). A higher score on the TEPS reflects better hedonic capacity. This questionnaire has been found to have good reliability, with the Cronbach's alpha coefficients of 0.83 for the whole scale, and 0.60–0.72 for the four factors.

2.4. Data analysis

Statistical analysis was carried out using the SPSS version 17.0 (SPSS, Chicago, IL). Analysis of covariance (ANCOVA) followed by Bonferroni post hoc tests were used to examine group differences in olfactory identification ability and the TEPS ratings after adjusting for age between schizophrenia patients, individuals with schizotypy, and controls. We examined the relationship between olfactory identification and the TEPS ratings in each group. Besides, in the cohort of schizophrenia participants, we also calculated correlations between olfactory identification ability, symptomatology and dosage of medications. The Shapiro-Wilk test was used to test for normality in each group. Pearson's correlation coefficient was used if the data were normally distributed, whereas the Spearman's correlation coefficient if the data were not normally distributed.

3. Results

The three groups differed significantly in age, but not in gender and educational level (see Table 1). The group difference in UPSIT total score reached statistical significance after controlling for age ($F(2,112) = 19.115$, $p < 0.001$), with post-hoc comparison showing that schizophrenia participants and schizotypy individuals having poorer