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Functional hemispheric asymmetry and nicotine dependency as variables mediating neurobiological vulnerability to schizotypy in a non-clinical population of college students

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ABSTRACT

In the present study, schizotypal personality traits and their neuropsychological correlates were examined amongst a non-clinical sample, so as to gain insight into the variables mediating neurobiological vulnerability to schizotypy. To that effect, 50 young adults completed the Oxford-Liverpool Inventory of Feelings and Experiences, the Fagerström Test of Nicotine Dependence, the Edinburgh Handedness Questionnaire, and a dichotic listening task. Analyses revealed a significant right-hemisphere dominance association to positive schizotypy, and a left-hemisphere dominance association to negative schizotypy. Nicotine dependence emerged as a significant correlate of positive and overall schizotypy, and left-hemisphere dominance. Gender-based interactions were significant for females on positive schizotypy, nicotine dependence and right-hemisphere dominance, and on negative schizotypy for males. The findings of this study can be used to advance our understanding of the factors of risk and resilience in the schizophrenia spectrum.

1. Introduction

Significant evidence suggests a relation between two apparently different phenomena arising from two diverse scientific fields: schizotypy from the field of psychopathology, and brain laterality from the field of neuropsychology (Weinstein & Graves, 2002). Schizotypy, particularly in a clinical context, is treated as a pathological condition (Mohr & Claridge, 2015). Meehl (1962) introduced schizotypy as a genetic diathesis-stress model, portraying the nature of the individual's latent proneness to schizophrenia (Lenzenweger & Korfine, 1992). Schizotypy is a condition characterised by mild psychotic-like symptoms. In non-clinical populations, schizotypal symptoms are quantitatively sub-clinical, yet qualitatively analogous, to those of schizophrenia (Barnett & Corballis, 2002; Premkumar et al., 2012). In other words, the construct represents a latent personality organization that harbours the liability for schizophrenia (Lenzenweger, 2006). Schizotypy prevalence is estimated at 0.6 to 1.1% of the general population (Lenzenweger, 2008).

Schizotypy is commonly assessed via self-report questionnaires, representing a dimensional approach to psychotic-like symptoms in dimensions known from the schizophrenia taxonomy; namely, positive [PS], negative [NS], and disorganized or cognitive disorganization [CogDis] schizotypy (Herzig et al., 2015). Popular measures include the Oxford Liverpool Inventory of Feelings and Experiences (O-LIFE; Oldfield, 1971), the Magical Ideation Scale (MI; Eckblad & Chapman, 1983) and the Schizotypy Personality Questionnaire (SPQ; Raine, 1991). Higher scores connote higher proneness to psychosis, displaying symptoms akin to those of schizophrenia patients, as well as similar cognitive (Buchy, Woodward, & Liotti, 2007), sensory-motor (Lenzenweger & Gold, 2000), neurophysiological (Mohanty et al., 2005; Shenton, Dickey, Frumin, & McCarley, 2001) and neurobiological (Murray, Lappin, & Di Forti, 2008) irregularities.

A partial, at least, aetiological overlap between schizotypy and schizophrenia presents a viable and congruent approach towards expanding our understanding of schizophrenia spectrum disorders. In lieu of established similarities and points of departure between the two constructs, it comes as no surprise that current scientific research is geared towards deepening an understanding of their underlying

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mechanisms (Lenzenweger & Korfine, 1992). Additionally, research on schizotypy offers a structured model of research observation by eliminating confounding effects of medication in schizophrenia patients. Moreover, research in schizotypy is of importance in its own right, as elevated schizotypy has been associated with substance misuse (Skosnik, Spatz-Glenn, & Park, 2001; Williams, Wellman, & Rawlins, 1996) and disturbances across educational, professional, emotional and social facets of one's life (Cohen, Mohr, Ettinger, Chan, & Park, 2015). Increasing our understanding of the mechanisms underlying the aforementioned disturbances could facilitate the evolution of intervention strategies (Ettinger et al., 2015).

1.1. Schizotypy risk factors: psychoactive (or psychotropic) substances

Converging evidence supports the idea that psychotropic substance consumption, such as cannabis (Barkus, Stirling, Hopkins, & Lewis, 2006; Barnes, Mutsatsa, Hutton, Watt, & Joyce, 2006; Skosnik et al., 2001) and nicotine (de Leon, Diaz, Rogers, Browne, & Dinsmore, 2002; Esterberg, Goulding, McClure-Tone, & Compton, 2009) heavily influence the trajectories of both schizotypal and schizophrenic taxonomies. The relationship between dopamine-enhancing drugs (i.e. nicotine) and psychotic symptoms has been examined in both clinical and non-clinical populations, confirming the deterioration of positive psychotic symptoms in the former, and the instigation of psychosis in the latter (Moore et al., 2007; Sekine et al., 2001; Smith et al., 2009). Hence, enhanced dopaminergic activity has unsurprisingly been associated with schizophrenia spectrum disorders (Liouta, Smith, & Mohr, 2008). In construction of an exploratory model, we can assume nicotine acting as a possible mediating environmental factor, imitating the effects of typical neurobiological vulnerability to schizophrenia-related disorders.

1.2. Schizotypy and functional brain laterality

Brain laterality with left-hemisphere dominance (LHD) in language processing and selective attention tasks, and right-hemisphere dominance (RHD) in face recognition tasks, which have been reported in healthy populations seem to be diminished in both schizophrenia and schizotypy (Cohen & Davis, 2009; Suzuki & Usher, 2009). Inconsistencies regarding the relation of schizotypal dimensions and brain laterality exist in research, with some studies associating PS or CogDis with RHD (Herzig, Tracy, Munafò, & Mohr, 2010; Leonards & Mohr, 2009; Mohr & Claridge, 2015; Suzuki & Usher, 2009), others with LHD (Liouta et al., 2008; Mason & Claridge, 1999), whereas some studies report no laterality at all (Gooding & Braun, 2004; Herzig et al., 2010; Najt, Bayer, & Hausmann, 2012).

Several factors might account for the heterogeneity of the aforementioned findings. The scale employed to evaluate schizotypy seems to play a role (Liouta et al., 2008; Schofield & Mohr, 2014), since so far studies employing the MI scale have reported RHD (Mohr et al., 2005; Weinstein & Graves, 2002), whereas studies with the O-LIFE inventory have reported either RHD (Suzuki & Usher, 2009) or LHD (Liouta et al., 2008). Additionally, studies differ in terms of the laterality task utilised to assess brain laterality, with some using LHD tasks like dichotic listening tasks and lexical decision tasks, whereas others use RHD tasks like visual face processing tasks. It should be noted that so far only two studies have employed both a RHD and a LHD laterality task and have found no significant relation between PS and brain laterality (Herzig et al., 2010; Schofield & Mohr, 2014).

Furthermore, findings are likely prone to gender differences: females have been found to score higher on PS, whereas males commonly score higher on NS (Miettunen & Jaaskelainen, 2010; Paíno-Piñeiro, Fonseca-Pedrero, Lemos-Giráldez, & Muñiz, 2008).

Another possible explanation of the inconsistent findings reported in the literature pertains to the elevated consumption of psychotropic substances (e.g. nicotine) commonly observed in schizophrenia populations. Herzig et al. (2010) recently examined the interaction between schizotypy, nicotine consumption and dependence on brain laterality, and demonstrated a RHD with elevated nicotine dependence, despite brain laterality having been found unrelated to nicotine consumption.

1.3. Aims and hypotheses

The aim of the present study was to examine the association between self-reported schizotypy, nicotine dependence and brain laterality in a non-clinical population. Due to the high heterogeneity of past findings, the pursuit of forming a definitive hypothesis was challenging. Nonetheless, we expected to find a significant relation between RHD and both PS and CogDis. No association was expected between NS and brain laterality. Regarding nicotine dependence, it was expected that higher nicotine dependence would be associated with elevated PS and brain laterality with RHD.

2. Method

2.1. Ethics & procedure

The project was reviewed by the Health and Human Sciences Ethics Committee with Delegated Authority and was allowed to proceed. The study was described in full to the participants, who were informed of the voluntary character of their participation and freely consented to participate.

2.2. Participants

Fifty students were recruited randomly on the basis of their presence at the campus of the Independent Science and Technology (IST) College in Athens, Greece. Ages ranged from 18 to 31 years (22.82 ± 2.82; 22.72 ± 2.59 for females; 22.92 ± 2.89 for males), with a female to male ratio of 1:1. Inclusion criteria consisted of (i) English fluency, (ii) right-hand dominance and (iii) normal auditory capacity. Left-handed and ambidextrous subjects were excluded to minimize the possibility of introducing reduced brain asymmetry -due to handedness- as a confounding variable. By large, RHD is known to reflect the typical structural pattern of cerebellar asymmetry (right > left cerebellar hemisphere), whereas other types of handedness have been reported to represent a reduced or ipsilateral brain asymmetry (Papaeiliou, Polemikou, & Michaelides, 2012). Auditory function was further screened using the online audiogram hearing test (Pigeon, 2007), to exclude any possibility of including participants with undiagnosed hearing impairments. Only subjects whose auditory threshold was higher than the clinical range (> 10 dB) were included in the present study. Any participants who self-disclosed a family history of psychiatric or neurological illness, recent head trauma or substance misuse were also excluded.

2.3. Instruments

The following assessment instruments were used in the following order of application: Audiogram hearing test, EHI, O-LIFE, FTND and a dichotic listening task.

2.3.1. Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE)

The O-LIFE questionnaire was used to evaluate schizotypal traits. The O-LIFE is a validated tool of 150 self-report items measuring psychosis-proneness (Mason & Claridge, 2006; Mason, Claridge, & Jackson, 1995). The instrument, which consists of four subscales, ranks high on internal consistency, ranging from $r = 0.72$ to $r = 0.89$ between the subscales (Mason et al., 1995) and test-retest reliability, ranging from $r = 0.76$ to $r = 0.93$ (Burch, Steel, & Hemsley, 1998). PS is measured by 30 questions associated with magical thinking, paranoid ideation and