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## Suspiciousness in young minds: Convergent evidence from non-clinical, clinical and community twin samples

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### ABSTRACT

**Background:** We validated the Social Mistrust Scale (SMS) and utilized it to examine the structure, prevalence, and heritability of social mistrust in a large sample of Chinese children and adolescents.

**Methods:** In Study 1, a large sample of healthy twins (N = 2094) aged 8 to 14 years (M = 10.27 years, SD = 2) completed the SMS. Structural equation modeling (SEM) was conducted to assess the structure of the SMS and to estimate the heritability of social mistrust in a sub-sample of twins (n = 756 pairs). In Study 2, 32 adolescents with childhood-onset schizophrenia were compared with 34 healthy controls on levels of suspiciousness and clinical symptoms to examine the associations between the SMS and the Positive and Negative Syndrome Scale (PANSS).

**Results:** We found a three-factor structure for social mistrust (home, school, and general mistrust). Social mistrust was found to be moderately - heritable (19%–40%), with mistrust at home most strongly influenced by genetic factors. Compared with 11.76% of the healthy controls, 56.25% of the adolescents with early-onset schizophrenia exhibited very high levels of social mistrust on all three subscales of the SMS. The SMS exhibited good discriminant validity in distinguishing adolescents with childhood-onset schizophrenia from healthy controls and showed associations with a broad range of symptoms assessed by the PANSS.

**Conclusions:** Social mistrust assessed by the SMS may be heritable. The SMS demonstrates good discriminant validity with clinical diagnoses of schizophrenia. However, it seems to be correlated with multiple aspects of psychopathology in the schizophrenia group, rather than being specific to delusional ideation/paranoia.

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### 1. Introduction

Persecutory delusions are one of the most common symptoms in schizophrenia (Sartorius et al., 1986). There is growing evidence suggesting that such delusions exist on a continuum of severity in adults in the general population, with many individuals reporting a few paranoid thoughts and a few individuals (10%–15%) reporting many paranoid thoughts (Bebbington et al., 2013; Chan et al., 2011; Freeman,

2006; Van Os et al., 2009). In studies of adult patients, paranoia has received much research attention as it has been found to co-occur with a host of psychological problems (e.g., anxiety, insomnia, suicidal ideation and poor emotional and cognitive functioning) (Berry et al., 2015; Combs et al., 2006; Freeman et al., 2011). However, whether paranoia exists developmentally in non-clinical adolescents and children remains understudied and previous adult studies have predominantly been conducted in Western populations.

To date, only one study has examined paranoia in non-clinical adolescents and children in both non-Western and Western samples (Wong et al., 2014). This large cross-sectional survey of 8 to 14 year-olds (N = 2498) from Hong Kong and the UK examined excessive suspiciousness, an attenuated form of paranoia, using the first dimensional

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measure of childhood suspiciousness: the *Social Mistrust Scale* (SMS). The study found that childhood suspiciousness was prevalent in 8 to 14 year-olds from both UK schools and Hong Kong international schools. Such suspiciousness was found to exist on a continuum of severity and was positively skewed: with many children being trusting and a few being mistrustful. Compared with trusting children, mistrustful children (defined as scoring 7 or above on the SMS) not only self-reported more internalizing and externalizing problem behaviors but also self-reported a greater level of mistrust in school rather than the home, which is also what we predict to be the case in our study.

Although Wong et al. (2014) found that there was no main effect of gender in either the UK or Hong Kong, there was a general age-related decline in levels of mistrust, with young children (8 to 10 years) reporting higher levels of mistrust than older adolescents (11 to 14 years). In the UK sample only, there was a gender x age interaction where mistrust was more common in boys than girls in younger children, but the pattern was reversed in children aged 10 and above. The authors suggested that these results were due to changes in school-related/education experiences (i.e. environmental influences) and brain maturation (i.e. genetic influences). With regard to environmental influences, as the children were from Hong Kong International schools and UK schools, the question of whether similar age and gender differences in levels of mistrust may be found in children with uniform educational experiences (such as mainland Chinese schoolchildren) has yet to be explored.

Another unanswered and important question pertains to the genetic and environmental influences of social mistrust. Twin studies of young adults in the general population have suggested moderate to high (about 50%) heritability estimates in paranoid ideation (Fagnani et al., 2011), with similar findings replicated in late adolescents (aged 16 years) (Shakoor et al., 2015a, 2015b, 2016). No sex difference in genetic and environmental influences on paranoia was evident (Shakoor et al., 2015a; Zavos et al., 2014). Paranoia, along with parent-rated negative symptoms, demonstrated the highest heritability (50%–54%) among all six kinds of psychotic experiences assessed by the Specific Psychotic Experiences Questionnaire (SPEQ) (Shakoor et al., 2015b, 2016; Zavos et al., 2014). Moreover, some studies have reported no difference in the heritability between the extreme group reporting the most severe and frequent psychotic experiences and the rest of the sample (Zavos et al., 2014). Together these results suggest that both paranoia in the general population and clinically diagnosed schizophrenia exist on the same continuum and may share common genetic variants. Hence, heritability estimates of paranoia in younger populations, and its socio-cultural influences in non-Western children and adolescents, may help identify a developmental window for the early identification of schizophrenia which has yet to be examined.

Mistrustful children scoring high on the SMS (>7 points) have also been shown to exhibit more internalizing and externalizing problem behaviors compared with trusting children in Wong et al.'s (2014) study. However, whether the SMS has any clinical utility is unclear. Thus, examining the associations of the SMS with standardized measures of symptoms (e.g., Positive and Negative Syndrome Scale (PANSS)) in early onset-schizophrenia would help establish its usefulness.

To this end, we conducted two related studies to address the above gaps. In Study 1, our first aim was to assess the prevalence and structure of social mistrust using exploratory and confirmatory factor analysis, as this is the first study of the Chinese SMS in a large sample of healthy Chinese twins aged 8 to 14 years ( $N = 2094$ ). We also conducted measurement invariance of the SMS across ages (younger vs. older children) and gender (female vs. male). Our second aim was to assess the heritability of mistrust in same-sex MZ and DZ twins ( $N = 756$  pairs). In Study 2, our third aim was to test the convergent validity of the SMS with the Positive and Negative Syndrome Scale (PANSS) in a sample of adolescents with childhood-onset schizophrenia ( $n = 32$ ) and healthy controls ( $n = 34$ ).

In Study 1, we hypothesized that social mistrust would be prevalent among a few of the children, following a positively skewed distribution. Social mistrust assessed by the SMS would follow a 3-factor structure and would be heritable in Chinese twins. In Study 2, we hypothesized that the SMS would be positively correlated with the PANSS, specifically with the “suspiciousness/persecution” item.

## 2. Methods

### 2.1. Participants

#### 2.1.1. Study 1

Healthy twins aged 8- to 14-years-old ( $M = 10.57$  years,  $SD = 2.0$ , males = 49.5%) from the Beijing Twin Study (BeTwiSt) (Chen et al., 2013) were recruited from Shenyang, China. This included monozygotic twins (MZ;  $n = 1311$ ), dizygotic twins (DZ;  $n = 323$ ) and opposite-gender twins (OG;  $n = 460$ ). Zygosity was determined by DNA analysis and questionnaire (Chen et al., 2010). The age and gender distribution of this sample is detailed elsewhere (Supplementary Table 1). Informed parental consent was obtained before the start of the study and children completed questionnaires in groups. This study was approved by the Ethics Committee of the Institute of Psychology at the Chinese Academy of Sciences.

To examine the heritability of social mistrust, we included only same-gender twin pairs (and not opposite-gender twin pairs), resulting in 1512 twins ( $M = 10.57$  years,  $SD = 2.01$ , males = 49.34%) with complete data. The final sample consisted of 616 pairs of MZ twins (males = 47.72%) and 140 pairs of DZ twins (males = 56.43%). We excluded opposite gender twin pairs in this subsample considering the following two reasons: (1) The influence of additive genetic factor and environmental factors on social mistrust (or the A, C, E parameters in the model) may vary in males and females (i.e., quantitative sex differences). (2) As for the opposite sex DZ twins, the correlations for the A factors ( $r_A$ ) and C factors ( $r_C$ ) may fall below the traditional value (i.e., 0.5 for  $r_A$ , 1 for  $r_C$ ) (i.e., qualitative sex differences).

#### 2.1.2. Study 2

Thirty-two adolescents with childhood-onset schizophrenia (males = 56.3%) recruited from Xiangya Hospital in Hunan, Shanghai Mental Health Centre, and Hong Kong ( $M = 13.91$  years,  $SD = 1.57$ , range = 10–16 years). These participants were compared with 34 healthy adolescent controls (males = 61.8%) recruited from junior high schools in Hunan ( $M = 13.03$  years,  $SD = 0.72$ , range 12–15 years). All patients were assessed by experienced psychiatrists (XLC, YQ, SSSL) using the PANSS (Kay et al., 1987). Patients met the DSM-IV-TR diagnostic criteria for schizophrenia (American Psychiatric Association, 1994) and were taking second-generation antipsychotic medication for not more than one year (mean chlorpromazine equivalence = 406.1 mg/day), with the exception of one 10-year-old drug-naïve patient. All healthy controls completed the 113-item behavioral problems section of the standardized Chinese version of the Child Behavior Checklist (CBCL; parental version) (Su and Li, 1996) and had individual syndrome subscale scores and a total problem score falling within the range of normal behavior. Adolescents with a history of any psychiatric illness, organic brain disorders, substance and/or alcohol abuse, and clinical evidence of mental retardation were excluded. Participants in the two groups did not differ in gender ratio but patients with schizophrenia were older ( $t[43] = 2.88$ ,  $p < 0.01$ ) and had significantly lower estimated IQ ( $t[50] = -9.09$ ,  $p < 0.01$ ) than healthy control adolescents (Supplementary Table 2).

All participants and their parents gave written informed consent before the commencement of the study. This study was approved by the Ethics Committees of the Institute of Psychology, the Chinese Academy of Sciences, the Xiangya Hospital in Hunan, the Shanghai Mental Health Centre and Castle Peak Hospital.

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