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Lexical and sub-lexical reading skills and their correlation to clinical symptoms in young Chinese patients with schizophrenia

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ABSTRACT

Patients with schizophrenia often experience severe reading deficits such as oral reading and reading comprehension deficits. However, it is not known whether different types of lexical or sub-lexical components in reading are also impaired. In order to address this issue, the present study had 22 young Chinese patients with schizophrenia and 22 young Chinese normal controls undergo a battery of reading tests, which specifically measures lexical and sub-lexical components of reading in Chinese. The schizophrenic group further underwent Brief Psychiatric Rating Scale (BPRS) in order to ascertain the severity of patients' clinical symptoms. The results showed that compared to the controls, (1) the schizophrenic patients performed significantly poorly in orthographic processing, orthography–phonology mapping, and orthography–semantic mapping tests and further that (2) their performances in orthographic processing, and orthography–semantic mapping skill tests negatively correlated with the BPRS score. Note however that their ability to access their mental lexicon was intact. There is thus a clear need for studies with a larger sample-size and neurobiological measures which would lead to our better understanding of the behavioral as well as the neural relationships between schizophrenic patients, and their reading processing impairments, thus developing effective reading intervention programs for the schizophrenic patients.

1. Introduction

Schizophrenia is a common mental disorder, and the prevalence in the population is generally estimated between 0.5% and 1.0% (Erritty and Wydell, 2013). In China, however, an incidence rate of 0.65% across lifespan has been reported (Chen et al., 1998). It is characterized by cognitive impairments involving memory, executive function, language and reading. Especially, recent studies found linguistic-cognitive deficits were associated with clinical symptoms, such as auditory hallucinations and thought disorders (Oertel-Knoechel et al., 2013; Tsao et al., 2013). Therefore, exploring the relationship between cognitive impairments and clinical symptoms is helpful for fully understanding the nature of this disorder. The finding will also promote more accurate diagnosis and more effective therapy programs (De Loye et al., 2013). For example, as reading is an essential skill for normal lives in modern society, many researchers investigated how reading skills might be affected by schizophrenia, and have repeatedly reported that reading skills were impaired in those individuals with schizophrenia (Clare et al., 1993; Dalby and Williams, 1986). Recently, Revheim et al. (2014) assessed reading ability and sensory function in individuals diagnosed with schizophrenia and found that all schizophrenic patients displayed both visual and phonological impairments, and further that more than 70% of the patients met the criteria for acquired dyslexia (Revheim et al., 2014).

In alphabetic language speaking countries, phonological processing skills are the single most crucial factor for the successful development/attainment of literacy skills. Indeed it has been reported that the individuals with schizophrenia showed deficits in both rapid naming and phonological awareness skills (Arnott et al., 2011; Whitford et al., 2013). Contrary to reading in alphabetic languages, in reading Chinese, orthography and semantic skills are shown to be more important, thus the relative contribution from phonology, orthography and semantics to reading vary widely according to different languages (Chen et al., 2009). Using

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statistical learning models, Yang and colleagues (Yang et al., 2009, 2013) found that although adults in general used the same basic reading processes across very different writing systems, the impact of semantics on reading performance was much greater in Chinese than English (Shibahara et al., 2003). In line with these cross-cultural differences in the way reading is being processed, many studies reported that Chinese speakers with developmental dyslexia had mixed deficits in morphological, orthographical, and phonological processing skills (Ho et al., 2007, 2004; Shu et al., 2006; Siok et al., 2009) unlike alphabetic language users with developmental dyslexia whose predominant deficit is in the phonological processing skills (Ramus et al., 2003; Savill and Thierry, 2011).

Against this background, it is necessary to examine how those multiple components of reading in Chinese might be affected in Chinese schizophrenic patients. Although some studies showed that general reading skills were impaired in schizophrenic individuals, hardly any systematic investigations have been conducted, especially in Chinese. For example, Tsao et al. (2013) revealed that Chinese adults with schizophrenia were less accurate than normal controls in discriminating lexical tones (a reading related cognitive skill), which in turn further correlated with the severity of schizophrenic symptoms (Tsao et al., 2013). However, this study only detected the deficit in a specific aspect of phonological processing, i.e., tone discrimination in reading, leaving other important reading-related skills in Chinese, such as orthographic and semantic skills in reading (Yang et al., 2009, 2013).

The Brief Psychiatric Rating Scale (BPRS) used in much psychiatric/psychological research is an effective instrument for assessing severity of psychotic symptoms among patients with mental disorders. Previous research has also demonstrated a strong correlation between BPRS scores and language skills. For example, (Horton and Silverstein, 2011) found that a significant correlation between language-related skills such as the processing skills in grammar, fluency and comprehension in sentences and BPRS scores in both deaf and hearing schizophrenic patients. Thus, following the above, the next question we need to address is whether there is a correlation between reading-related sub-lexical/lexical skills and the BPRS. Based on previous studies, the current study aims to explore whether the most important sub-lexical and lexical reading skills in Chinese, i.e., orthographic, orthography–phonology mapping, and orthography–semantic mapping skills as well as abilities to access mental lexicon might be impaired in Chinese patients with schizophrenia. The study will further explore the relationships between possible sub-lexical and lexical skills deficits and clinical symptoms.

2. Methods

2.1. Participants

There were in total 44 participants who took part in the study, 22 of whom were patients with schizophrenia and the other 22 were normal controls. The schizophrenic patients (age range: 18–30; 12 males) were recruited from Peking University Sixth Hospital in Beijing, China. Criteria for inclusion were: (1) individual's symptoms met the diagnostic criteria for schizophrenia in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV); (2) no nervous system diseases or any other psychotic disorders besides schizophrenia; (3) right-handed; and (4) they were assessed using the Brief Psychiatric Rating Scale (BPRS). Those individuals were excluded (i) if Chinese was not their first language; and (ii) if they had a current substance abuse or history of substance abuse in the last month. All but two patients used antipsychotics medication on conventional doses. See more details in Table 1.

The normal controls were volunteers (age range: 18–30; 13 males) working in Peking University Sixth Hospital and Beijing Normal University. The criteria for inclusion were that (1) none of the participant's second-degree and third-generation relatives had history of psychosis, (2) no history of psychotic disorders or nervous system diseases and (3) were right-handed.

Table 1
Sample characteristics for patients and controls [mean (S.D.)].

	Patients ($n=22$)	Controls ($n=22$)	Partial Eta squared	p value[b]
Age	24.36(4.03)	23.14(1.94)		0.205
Gender (M/F)[a]	12/10	13/9		1.000
Education	14.77(1.06)	15.00(0.01)		0.323
O	36.61(9.41)	63.61(9.23)	0.687	<0.001
O–P	19.43(5.46)	30.51(7.62)	0.423	<0.001
O–S	28.09 (10.22)	46.09(7.46)	0.515	<0.001
Mental lexicon	18.94(5.20)	19.44(4.61)	0.003	0.737
Length of illness	5.51(3.50)	–		
BPRS	36.67(8.63)	–		
Daily chlorpromazine equivalent (mg)	733.73 (582.16)	–		

Note: O for orthography, P for phonology, S for semantics.

[a] M for male and F for female.

[b] χ^2 test for gender, independent-sample t test for the other measures.

The patients and controls did not differ significantly in gender ($p=1.000$), age ($p=0.205$) and years of education ($p=0.323$) at group level. This study was approved by Peking University Sixth Hospital Ethics Committee and informed written consent was obtained from each normal participant and the guardian of each patient.

2.2. Reading measurements

A battery of reading tests consisting of an 'orthographic test', an 'orthography–phonology mapping test', an 'orthography–semantics mapping test', and a 'lexical access ability test' was administered. Each of the tests had time limits (see below), so no participant could finish all the items on any task. Several practice items were provided before each of the formal tests. The scores were adjusted by subtracting the number of false-alarm items from the number of hit items. Therefore, a higher score indicates a higher test performance and thus better sub-lexical as well as lexical skills (Xu et al., 2015; Zou et al., 2012).

2.2.1. A Nonword Cross-out test

was used to assess orthographic processing skills. The task consisted of 100 nonwords and 208 high frequency Chinese characters as stimuli. All the items were presented in a random order. Participants were asked to mark all the nonwords with a slash "\" as accurately and quickly as possible within 40 s (Zou et al., 2012).

2.2.2. An Onset Judgment test

was used to measure orthography–phonology mapping skills. This task consisted of 308 single-character words as stimuli. They were all familiar words with an average word frequency of approximately 125 times per million. The pronunciation of 100 of the items began with /b/ (e.g., '北, /bei3/'), whereas the remaining items did not (e.g., '回, /hui2/'). The items were presented randomly. Participants were asked to mark all the words produced with an initial /b/ with a slash "\" as quickly and accurately as possible. The time limit for this task was 80 s (Zou et al., 2012).

2.2.3. An Animal Word Cross-out test

was used to measure orthography–semantics mapping skills. This task consisted of 220 two- or three-character compound words as stimuli, 74 of which were animal words, such as "青蛙" (/qing1wa1/, frog). They were all familiar words with an average word frequency of approximately 16 times per million. Animal and non-animal words were presented in a random order. Participants were asked to mark all the animal words with a slash "\" as quickly and accurately as possible. A 50-s time limit was given (Zou et al., 2012).

2.2.4. A Pseudo-Homophone Discrimination test

was used to measure ability to access word lexicon. This task consisted of 220 two-character words as stimuli, all of which were familiar with an estimated word frequency of 27 times per million. 72 had one character replaced with another that was pronounced the same, producing a pseudo-homophone, which does not exist in Chinese (e.g., '何花', /he2hua1/). The pseudo-homophones and real words were presented in a random order. Participants were asked to cross out all pseudo-homophones with a slash "\" as accurately and quickly as possible within 70 s (Zou et al., 2012).