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Impaired reading comprehension in schizophrenia: Evidence for underlying phonological processing deficits

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ABSTRACT

The present study examined reading ability in high functioning people with schizophrenia. To this end, 16 people with schizophrenia who were living in the community and 12 matched controls completed tests of passage reading (comprehension, accuracy, and rate), word recognition, and phonological processing (phonological awareness, phonological memory and rapid naming) and ratings of reading self-concept and practices. Performance of the participants with schizophrenia was impaired relative to control participants on reading comprehension and rapid naming and relative to the population norms on phonological awareness, and rapid naming. In addition, self-rating data revealed that participants with schizophrenia had poorer perceptions of their reading ability and engaged in reading activities less frequently than their control counterparts. Consistent with earlier research, significant correlations were found between phonological awareness and reading comprehension. These findings expand on previous research in the area to suggest that community-based individuals with schizophrenia experience problems with reading comprehension that may have a phonological basis.

1. Introduction

People with schizophrenia experience wide-ranging cognitive deficits including communication and oral language problems. Evidence of schizophrenia-related reading difficulties has also emerged (e.g. Hayes and O'Grady, 2003; Revheim et al., 2006a), however, the underlying processing deficits associated with poor reading in this population are yet to be clearly established. While this is not to suggest that reading deficits are likely to be a fundamental aspect of the disease, given that reading is an essential skill for everyday living and functioning, and a core prerequisite for many psychoeducational programs in mental health, there is an urgent need to understand reading difficulties in schizophrenia and to develop appropriate intervention programs. Accordingly, the present study sought to further elucidate the nature of reading difficulties in schizophrenia.

Investigations into reading in schizophrenia are limited. Hayes and O'Grady (2003) employed the Reading Comprehension Battery for Aphasia (RBCA) (LaPointe and Horner, 1979) with a group of 30 people with schizophrenia, the majority of whom were males who were living in a rehabilitation unit in a psychiatric hospital. The results indicated that participants with schizophrenia took significantly longer to complete the test than controls and performed worse on nine of the 10 subtests, exhibiting impaired word, sentence, and paragraph comprehension. Of particular concern was that the people with schizophrenia performed most poorly on the functional reading comprehension subtest. Given that the task did not require background knowledge and that comprehension was measured in response to multiple choice questions, the authors contended that "real-life" functional reading comprehension may in fact be even poorer in this population.

Further research reported a link between deficits in working memory function and reading comprehension in schizophrenia (Bagner et al., 2003). Bagner et al. examined reading rate and comprehension for sentence stimuli manipulated for length and syntactic complexity. In addition, the authors explored the relationship between comprehension, working memory, and disease symptoms such as hallucinations and thought disorder. Consistent with the findings of Hayes and O'Grady (2003), participants with schizophrenia exhibited impairments in overall comprehension and rate, with comprehension decreasing as a function of sentence length but not complexity. Further, while results did not support the hypothesised relationship between disease symptoms and comprehension, a significant correlation was found between working memory ability and comprehension.

With respect to the etiology of schizophrenia-related reading impairments, Condray (2005) has hypothesised a neurodevelopmental cause that links reading deficits in schizophrenia to developmental dyslexia though this link is yet to be clearly established. Several lines of evidence suggest that reading impairment in schizophrenia

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emerges in adolescence (Fuller et al., 2002; Reichenberg et al., 2002; Weiser et al., 2004). Associations have been reported between very poor reading comprehension in adolescent males with normal general cognitive function and increased risk of both developing schizophrenia later in life (Weiser et al., 2004) and later hospitalisation for schizophrenia (Weiser et al., 2007). Further, retrospective studies have demonstrated that participants who were later diagnosed with schizophrenia exhibited poorer reading accuracy and reading comprehension prior to the onset of their illness (Fuller et al., 2002; Reichenberg et al. 2002). It is less clear, however, whether reading problems in schizophrenia, as in developmental dyslexia, can be attributed to an underlying phonological processing impairment.

Three related yet distinct aspects of phonological processing have been proposed to contribute to reading (Wagner et al., 1999). These are phonological awareness, phonological memory and rapid naming. Phonological awareness refers to an individual's explicit awareness of the sound structures of words and includes the ability to rhyme, substitute, and manipulate sound segments (Catts, 1991). Phonological memory refers to the process by which phonological information is stored temporarily in working memory and is often assessed using nonword repetition tasks (Wagner et al., 1999). Finally, rapid naming is viewed as a measure of the individual's ability to automatically retrieve phonological information from long term memory and is particularly important for the development of reading fluency (Wagner et al., 1999). Numerous studies have shown a relationship between impaired phonological processing and poor reading ability in both children (Wagner and Torgesen, 1987; Adams, 1990; Bowers and Wolf, 1993; Siegel, 1993; Wagner et al., 1994; Wolf and Bowers, 1999) and adults (Pratt and Brady, 1988; Pennington et al., 1990; Gottardo et al., 1997; Bone et al., 2002; Loureiro et al., 2004; Sawyer, 2006).

To date, only one study has explored the relationship between reading performance and phonological processing in schizophrenia (Revheim et al., 2006a). Consistent with earlier research (Bagner et al., 2003; Hayes and O'Grady, 2003), Revheim et al. reported significant deficits in reading comprehension and reading rate in participants with schizophrenia as compared to both their control counterparts and to adult population norms. In addition, the schizophrenia group performed worse than population norms in phonological awareness, phonological memory, and rapid naming but were impaired relative to the control group on tests of PA only (segmenting and blending nonwords). Further, phonological awareness performance was positively correlated with passage reading comprehension as measured by multiple choice questions. As in earlier research (Hayes and O'Grady, 2003), participants with schizophrenia were predominately males who were not living independently in the community with over a third of participants having such low levels of global functioning that they required maximum supervision. Accordingly, further research into phonological processing and reading with higher functioning individuals is needed to further profile reading problems in schizophrenia.

To this end, the objective of the present study was to examine the reading performance (reading comprehension, reading accuracy and reading rate) and phonological processing skills (phonological awareness, phonological memory, and rapid naming) of people with schizophrenia who were living independently in the community. The current research also aimed to investigate the relationship between these measures. Based on previous research in the area (Bagner et al., 2003; Hayes and O'Grady, 2003; Revheim et al., 2006a), it was hypothesised that people with schizophrenia would exhibit abnormal reading performance and related phonological processing deficits. Further, it was predicted that phonological processing abilities would be correlated with reading performance. To date, no study has examined how often people with schizophrenia engage in reading activities and how they perceive their reading performance. Accordingly, the current study also sought to explore reading practices and self-concept in schizophrenia. It was hypothesised that people with schizophrenia would read less frequently than controls and, based on the paediatric research in reading self-concept (Chapman et al., 2000), have decreased self-perceptions relative to control participants. A positive relationship was also predicted between reading self-concept and reading performance.

2. Methods

2.1. Participants

Sixteen people (10 males and six females) who had a diagnosis of DSM-III-R schizophrenia and were living in the community and 12 healthy controls (six males and six females) matched to the participants with schizophrenia for gender, age and education level participated in the present study. All participants gave informed consent. Participants were excluded if: English was not their first language; they had a current substance abuse or history of substance dependence or withdrawal in the last three weeks; they had a history of neurological impairment in addition to schizophrenia or of neurological surgery; or they reported a history of behavioural, learning, or reading difficulties. There were no significant differences between the two groups with respect to age ($Z=-0.093$, $p=0.926$) or education ($Z=-0.560$, $p=0.575$).

The Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1989) and the Scale for the Assessment of Thought, Language and Communication (TLC) (Andreasen, 1986) were used to assess the symptoms of schizophrenia. As per McGrath et al. (2001), six symptom summary scores were obtained. These were: a positive symptom score (P); a negative symptom score (N); a general psychopathology score (G); a reality distortion score (RDS); a psychomotor poverty score (PPS); and a thought disorder summary score (TDSS). See Table 1 for further details of each participant group.

2.2. Assessments

The Neale Analysis of Reading Ability — Third Edition (NARA) (Neale et al., 1999) involves reading aloud and measures reading comprehension (in response to open ended questions; maximum score = 44), accuracy (number of errors including mispronunciations, substitutions, refusals, additions, omissions, and reversals), and rate (words per minute). Raw scores were used as normative data is only provided for children up to 13 years of age.

Three subtests of the Woodcock Reading Mastery Test — Revised (WRMT-R) (Woodcock, 1998) were employed. *Word Identification* (words) and *Word Attack* (nonwords) form the Basic Skills composite score, a measure of word recognition while *Passage Comprehension* was included to further assess reading comprehension for passages using silent reading and a sentence cloze response format. Subtest raw scores were converted to standard scores with a mean of 100 and a SD of 15.

The Reading Comprehension Battery for Aphasia — Second Edition (RCBA-2) (LaPointe and Horner, 1998) measures the comprehension of single words, sentences, paragraphs, functional information, synonyms and morpho-syntactic information using a multiple choice response format and silent reading. Each of the test's 10 core subtests was scored for accuracy and the time taken to complete each subtest was added to provide a total reading time.

The three components of phonological processing, phonological awareness (PA), phonological memory (PM), and rapid naming (RN), were assessed using the six core subtests of the Comprehensive Test of Phonological Processing (CTOPP) (Wagner et al., 1999). These were: *Elision* and *Blending Words* (CTOPP-PA), *Memory for Digits* and *Nonword Repetition* (CTOPP-PM), *Rapid Digit Naming* and *Rapid Letter Naming* (CTOPP-RN). A further measure of PA was obtained using the supplementary subtests *Blending Nonwords* and *Segmenting Nonwords (CTOPP-APA)*. For the RN subtests, the raw score obtained is the total number of seconds taken to complete the naming of all stimuli. For

Table 1
Characteristics of the participant groups.

	Group	
	Schizophrenia	Control
N	16	12
Male:Female	10:6	6:6
Age (yr)	41.19 (13.43)	42.17 (15.56)
Education (yr)	11.88 (1.78)	11.75 (2.18)
Disease duration (yr)	14.88 (12.50)	–
Age at onset (yr)	25.15 (5.93)	–
Daily chlorpromazine equivalent (mg)	417.86 (375.22)	–
PANSS-P	17.77 (8.11)	
PANSS-N	17.38 (7.05)	
PANSS-G	33.23 (9.19)	
PANSS-RDS	9.23 (4.19)	
PANSS-PPS	10.08 (5.30)	
TDSS	1.62 (2.40)	

Note. Data are expressed as mean (SD).