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Building a neurocognitive profile of thought disorder in schizophrenia using a standardized test battery

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ABSTRACT

A core symptom of schizophrenia is thought disorder (TD). The cognitive abilities of semantic processing and executive function are argued to be etiologically linked to TD. However, there has been no comprehensive investigation of neurocognition in TD to date. The neurocognitive profile of 58 schizophrenia patients and 48 healthy controls was examined using the MATRICS Consensus Cognitive Battery and the D-KEFS Color–Word Interference Test. TD patients performed more poorly than non-TD patients on the cognitive domains of Verbal Learning and Inhibition, reflective of semantic and executive function respectively, confirming their critical roles over and above other cognitive deficits in schizophrenia.

1. Introduction

Formal thought disorder (TD) is regarded as a cardinal symptom of schizophrenia (Goldberg and Weinberger, 2000), and is characterized by aberrant speech patterns and inappropriate word use. Investigations into these speech symptoms have noted their increased severity during acute psychosis (Harrow et al., 1986) and have identified poorer prognosis in those with TD (Marengo and Harrow, 1997; Wilcox et al., 2012); however, the causal underpinnings of this phenomenon are still being debated. A popular avenue of research has been to explore the relationship between TD and the established cognitive impairments observed in schizophrenia. If the origins of TD are indeed cognitive in nature, exacerbated cognitive impairments should be observed in TD versus non-TD patients. To this end, the strongest evidence has emerged for compromised executive functioning (McGrath et al., 1997; Kerns and Berenbaum, 2002; Barrera et al., 2005) and abnormal semantic processing (Spitzer et al., 1993; Goldberg et al., 1998; Soriano et al., 2008). There have also been suggestions of compromised attentional and working memory capacity (Hotchkiss and Harvey, 1990; Docherty et al., 1996).

While there have been a number of studies targeting specific cognitive domains purported to underlie TD, there has not been a comprehensive examination of general neurocognition in TD patients compared to schizophrenia patients without current TD (NTD). For this study, the decision was taken to use the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008) as it is a recognized and standardized battery for the assessment of general neurocognition in schizophrenia with seven separate domains: Speed of Processing (SP), Attention/Vigilance (ATT), Working Memory (WM), Verbal Learning (VERL), Visual Learning (VISL), Reasoning and Problem Solving (RPS), and Social Cognition (SOC). The VERL domain is an assessment of semantic function. The D-KEFS Color–Word Interference Test (D-KEFS Stroop; Delis et al., 2001) was also included as an additional measure of inhibition and executive function.

This study thus aimed to examine the neurocognitive profile of schizophrenia patients with TD using standardized neurocognitive tasks; the MCCB and the D-KEFS Stroop. In line with the literature, we hypothesized that the schizophrenia participants would perform more poorly than controls on all cognitive domain measures. We also expected TD patients to perform more poorly than NTD patients in the domains of Verbal Learning reflecting semantic processing, and inhibition reflecting executive ability as well as Attention and Working Memory.

2. Method

Fifty-eight individuals with DSM-IV schizophrenia/schizoaffective disorder were recruited. Diagnosis was confirmed using the MINI500 (and confirmed by treating clinician) and symptoms assessed with the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) and the Thought, Language and Communication Scale (TLC; Andreasen, 1986); the latter used to classify patients into the TD and NTD groups

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Table 1
Comparison of demographic and clinical variables of the sample.

	TD ($n = 10$)	NTD ($n = 48$)	HC ($n = 48$)	Contrasts
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	
Age (years)	43.90 (7.31)	43.38 (11.41)	39.83 (13.89)	TD = NTD = HC
Gender (% male)	80.00	47.90	41.70	TD = NTD = HC
Premorbid IQ (WTAR)*	92.90 (16.24)	102.96 (12.57)	109.19 (8.45)	TD < NTD < HC
Age of onset	21.00 (7.58)	23.75 (6.68)	–	–
Length of illness	22.56 (11.91)	19.62 (12.02)	–	–
Medication (CPZE)	605.28 (303.78)	449.75 (444.83)	–	–
PANSS positive*	19.70 (5.27)	14.58 (4.59)	–	–
PANSS positive w/o TD[a]	14.1 (3.93)	11.54 (3.83)	–	–
PANSS negative	15.40 (6.65)	13.52 (5.21)	–	–
TLC score*	8.70 (7.47)	.83 (1.08)	.00 (.00)	TD > NTD = HC

Note: All comparisons done with one-way ANOVAs (Tukey's HSD post-hoc), with the exception of gender (chi-square test of independence). WTAR = Wechsler Test of Adult Reading. CPZE = chlorpromazine equivalence. PANSS = Positive and Negative Syndrome Scale — positive score range from 8 to 29 and negative score range from 7 to 28. TLC = Thought, Language and Communication Scale (total score range from 0 to 27).

[a] PANSS positive excluding TD-related items P2 & P4.

* $p < .05$.

based on ratings of recorded speech samples. All clinical ratings, including TD, were completed blind to cognitive performance by another trained researcher. The TD group were those that scored ≥1, with NTD patients scoring 0, on the global TD rating (0–4). 48 healthy controls (HCs) with no prior history of mental illness or anti-psychotic medication use were also recruited. Participants were also screened for history of traumatic brain injury, substance abuse and neurological disorders (e.g. epilepsy). Demographic and clinical characteristics of all participants are shown in Table 1.

All participants completed the 10 component tasks of the MCCB (see Table 2 for descriptions) and the D-KEFS Stroop. The Wechsler Test of Adult Reading (WTAR; Wechsler, 2001) was used as a measure of premorbid intelligence. Participant raw performance scores on all cognitive tasks were converted to z-scores using healthy control performance as a baseline. These were then converted into 7 cognitive domain scores according to MCCB definitions. Stroop scores were kept separate, reflecting the inhibition/executive function (EF) domain, and z-scores were created in the same manner. These 8 domain scores were compared using one-way ANCOVAs, controlling for premorbid intelligence (WTAR). Tukey's HSD test was used for post-hoc comparisons. Statistical significance levels were Bonferroni-corrected for multiple comparisons at $p < .005$.

3. Results

As can be seen in Fig. 1, performance of both TD and NTD patients tended to be poorer than HCs across all tasks. The impairment in both schizophrenia groups was significant across all domains except WM (NTD — $p = .16$ and TD — $p = .17$). Only NTD patients performed more poorly than HCs on SOC. When compared to NTD patients, TD patients had significantly poorer performance only in the VERL and INHB domains.

4. Discussion

The first hypothesis was partly supported, with schizophrenia patients showing poorer cognition on 6 out of the 8 domains, the exceptions being the WM and SOC domains. The second hypothesis was also partly supported, with significantly poorer performance only on the Verbal Learning and Inhibition domains distinguishing TD from NTD patients.

Table 2
Descriptions of MCCB component tasks by domain.

Cognitive domain	Test	Description
Speed of Processing	Brief Assessment of Cognition in Schizophrenia (BACS): Symbol-coding	Timed paper-and-pencil test; participant writes numbers that correspond to nonsense symbols based on a given key
	Category Fluency: Animal naming	Oral test; participant is asked to name as many animals as he/she can in 1 min
	Trail Making Test: Part A	Timed paper-and-pencil test; participant draws a line to connect consecutively numbered circles placed irregularly on a sheet of paper
Attention/Vigilance	Continuous Performance Test — Identical Pairs (CPT-IP)	Computer-administered measure of sustained attention; participant presses a response button to consecutive matching numbers
Working Memory	Wechsler Memory Scale — 3rd Ed. (WMS-III): Spatial Span	The researcher taps a sequence of cubes in increasing levels of difficulty on a board on which 10 cubes are irregularly spaced. The participant then taps the cubes in either the same or a reverse sequence to the researcher.
	Letter–Number Span	Orally administered test; participant mentally rearranges strings of random numbers and letters and repeats them to researcher
Verbal Learning	Hopkins Verbal Learning Test — Revised (HVLT-R)	Orally administered test where a list of 12 words from three semantic categories is presented and the participant asked to recall as many as possible after each of three learning trials
Visual Learning	Brief Visuospatial Memory Test — Revised (BVMT-R)	A test that involves a 30 second display of six geometric figures, and the participant then reproducing them from memory
Reasoning and Problem Solving	Neuropsychological Assessment Battery (NAB): Mazes	Seven timed paper-and-pencil mazes of increasing difficulty that measure planning and online troubleshooting
Social Cognition	Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT): Managing emotions	Paper-and-pencil multiple-choice test that assesses how people respond to scenarios