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Motivated to do well: An examination of the relationships between motivation, effort, and cognitive performance in schizophrenia

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ABSTRACT

The uncertain relationship between negative symptoms, and specifically motivational deficits, with cognitive dysfunction in schizophrenia is in need of further elucidation as it pertains to the interpretation of cognitive test results. Findings to date have suggested a possible mediating role of motivational deficits on cognitive test measures, although findings from formal examinations of effort using performance validity measures have been inconsistent. The aim of this study was to examine the relationships between motivation, effort exerted during cognitive testing, and cognitive performance in schizophrenia. Sixty-nine outpatients with schizophrenia or schizoaffective disorder were evaluated for psychopathology, severity of motivational deficits, effort exerted during cognitive testing, and cognitive performance. Motivation and degree of effort exerted during cognitive testing were significantly related to cognitive performance, specifically verbal fluency, verbal and working memory, attention and processing speed, and reasoning and problem solving. Further, effort accounted for 15% of the variance in cognitive performance, and partially mediated the relationship between motivation and cognitive performance. Examining cognitive performance profiles for individuals exerting normal or reduced effort revealed significant differences in global cognition, as well as attention/processing speed and reasoning and problem solving. These findings suggest that cognitive domains may be differentially affected by impairments in motivation and effort, and highlight the importance of understanding the interplay between motivation and cognitive performance deficits, which may guide the appropriate selection of symptom targets for promoting recovery in patients.

1. Introduction

Motivational deficits have long been recognized as a central feature of schizophrenia (Kraepelin, 1919; Bleuler, 1950), and along with diminished expression comprise the two core subdomains of negative symptoms in the illness (Foussias and Remington, 2010; Messinger et al., 2011). Clinically, motivational deficits refer to a diminishment in goal-directed behavior and the associated internal processes (such as interest, curiosity, and drive) that prompt the individual to plan, initiate, and pursue activities (Andreasen, 1982; Marin et al., 1991; Nakagami et al., 2008). These motivational deficits have been shown to play important roles in predicting cross-sectional and longitudinal functional outcomes in schizophrenia (Sayers et al., 1996; Kiang et al., 2003; Faerden et al., 2009a; Foussias et al., 2009; Faerden et al., 2010; Foussias et al., 2011; Konstantakopoulos et al., 2011; Evensen et al., 2012; Fervaha et al., 2014a,b). Recent work examining the interaction between negative symptoms and cognitive impairments, and their respective relationships with functional outcomes, has also revealed that negative symptoms, and specifically motivational deficits, mediate the relationship between cognition and functioning (Nakagami et al., 2008; Gard et al., 2009; Ventura et al., 2009; Green et al., 2012).

Motivational deficits have also been found to exhibit a direct relationship with cognitive impairments seen in schizophrenia. Early work revealed that motivational deficits seen in individuals with psychotic disorders were linked to poor performance on tests of attention, vigilance, and verbal memory (Schmand et al., 1994). Similarly, clinical measures of motivation have shown significant relationships with cognitive performance, and specifically with verbal fluency, working memory, attention and set-shifting, processing speed, and verbal learning and memory in individuals with schizophrenia (Addington and Addington, 1999; Roth et al., 2004; Nakagami et al., 2008; Faerden et al., 2009b; Gard et al., 2009; Konstantakopoulos et al., 2011; Fervaha et al., 2014c). In addition, a recent examination of the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) schizophrenia

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study revealed a significant link between longitudinal change in motivation and change in cognitive test performance (Fervaha et al., 2014c). Furthermore, monetary incentives have been found to improve performance on some cognitive tasks, such as the Wisconsin Card Sorting Task (Heaton, 1981), the Span of Apprehension (Asarnow and Nuechterlein, 1987), and facial emotion recognition tasks (Summerfelt et al., 1991; Kerr and Neale, 1993; Kern et al., 1995; Penn and Combs, 2000). Importantly, this has not been consistent across all studies (Green et al., 1990), suggesting that motivation may differentially impact performance across cognitive domains. Such findings have raised questions of whether some of the cognitive impairment seen in patients with schizophrenia is driven by a lack of motivation to do well on cognitive tasks (Barch, 2005).

An alternative approach to investigate the impact of motivational deficits on cognitive performance has been to assess the degree of effort individuals exert during cognitive testing using performance validity tests (PVTs). Such PVTs often employ forced-choice tasks whereby individuals are presented a series of verbal or visual stimuli, followed by presentation of stimulus pairs from which they must identify the one previously presented (Bianchini et al., 2001). While frequently employed in the context of litigation and compensation evaluations whereby an external incentive is present, PVT use has not been without controversy given the absence of a "gold standard" for cognitive effort and their validation based on simulation or known-group designs (Bianchini et al., 2001; Bigler, 2012). Nonetheless, PVTs are essential in the interpretation of neuropsychological test data so as to understand whether participants are providing sufficient effort during testing (Sharland and Gfeller, 2007; McCarter et al., 2009; Fox, 2011). PVTs have also been increasingly used for the assessment of effort in non-litigation settings, including in children, adolescents, healthy university students, and in neurological disorders (Merten et al., 2007; Locke et al., 2008; Axelrod and Schutte, 2011; Kirk et al., 2011; An et al., 2012; Brooks et al., 2012; Wisdom et al., 2012).

Across psychiatric populations, investigations have demonstrated that depression and anxiety disorders do not impact PVT scores (reviewed in Goldberg et al., 2007). In schizophrenia, however, there have been mixed findings. Early studies using PVTs identified 13% to 27% of individuals with schizophrenia as exerting reduced effort (i.e., failing the PVT) (Back et al., 1996; Goldberg et al., 2007). Ensuing work by Egeland et al. (2003), comparing individuals with schizophrenia, depression, and healthy controls found that 5% of individuals with schizophrenia exerted reduced effort, not significantly different from other groups where no individuals exerted reduced effort. Another investigation of individuals with psychotic disorders using the Test of Memory Malingering (TOMM; (Tombaugh, 1996)), one of the most frequently used PVTs (Sharland and Gfeller, 2007; McCarter et al., 2009), found that 8% of participants exerted reduced effort (Duncan, 2005).

A subsequent examination by Gorissen et al. (2005) investigated effort and cognitive performance in individuals with schizophrenia using another common PVT, the Word Memory Test (WMT). They found the prevalence of reduced effort to be 72% in the schizophrenia group, compared to 25% in the psychiatric control group, 10% in the neurological control group, and 0% in the healthy control group, with effort accounting for between 14% and 35% of the variance in cognitive test scores (Gorissen et al., 2005). In contrast, another study also using the WMT to assess effort in schizophrenia found much better performance, with average scores on the WMT comparable to the psychiatric control group in Gorissen et al. (2005) (Avery et al., 2009). Similarly, a recent investigation by Strauss et al. (2015) found that 15% of schizophrenia participants exhibited reduced effort on the WMT, with effort being a significant predictor of global cognitive impairment. Finally, an examination of performance across seven PVTs reported that 19% of participants with psychotic disorders exhibited reduced effort determined by failure on a single PVT, although with a lower prevalence of reduced effort (7%) when using more stringent criteria (i.e., failure on two PVTs) (Schroeder and Marshall, 2011).

Given the relationships between motivational and cognitive deficits with functional outcomes in schizophrenia, disentangling the impact of motivation on cognitive functioning is essential as we strive to identify critical treatment targets to improve functional outcomes in this illness. Accordingly, the aim of the present study was to investigate the relationships between motivation, effort exerted on cognitive testing, and cognitive test performance in schizophrenia. In this context, effort assessed through PVT performance served as an objective index of motivation to do well during cognitive testing. We also sought to examine the relationship of effort as measured by the TOMM with cognition both as a continuous and dichotomous construct. This was driven in large part by the recognition that classification of effort as normal or reduced, while useful for forensic evaluations, may not accurately capture the variations in effort that individuals with schizophrenia may exhibit when undertaking cognitive testing. We hypothesized that both clinical measures of motivation and effort exerted on cognitive testing would be significant predictors of cognitive test performance, with effort mediating the relationship between motivation and cognitive test performance. Further, we hypothesized that individuals exhibiting reduced effort on cognitive testing would have significantly lower cognitive test performance.

2. Methods

2.1. Participants

Individuals between the ages of 18 and 55 with a DSM-IV diagnosis of Schizophrenia or Schizoaffective Disorder, determined by the Mini International Neuropsychiatric Interview for Schizophrenia and Psychotic Disorders Studies (MINI) (Sheehan et al., 1998), were recruited at the Centre for Addiction and Mental Health, Toronto, Canada. All participants were outpatients on stable doses of antipsychotic medications for at least 4 weeks. Participants were excluded from the study if they: met criteria for substance abuse or dependence within the past 3 months (excepting nicotine), or other DSM-IV Axis I disorders; had a history of neurological disease; were experiencing significant akathisia (a rating of >2 on the Barnes Akathisia Rating Scale Global item (Barnes, 1989)), or significant extrapyramidal symptoms (a rating of >2 on more than 2 items of the Simpson Angus Rating Scale (SARS) (Simpson and Angus, 1970)).

2.2. Instruments and procedures

Positive and negative symptom severity was evaluated with the Scale for the Assessment of Positive Symptoms (SAPS) (Andreasen, 1984), and the Scale for the Assessment of Negative Symptoms (SANS) (Andreasen, 1982), respectively. SAPS total score consisted of the sum of all items excluding global items, while SANS total score consisted of the sum of all items excluding the attention subscale and global items. Further, negative symptoms were separated into their 2 core subdomains: Diminished Expression and Amotivation (reviewed in (Foussias and Remington, 2010)). The SANS Diminished Expression subdomain was comprised of the Affective Flattening subscale and the Poverty of Speech item (excluding inappropriate affect, poverty of content of speech, blocking, response latency, and global items). The SANS Amotivation subdomain was comprised of the Avolition–Apathy and Anhedonia–Asociality subscales (excluding global items). Amotivation was also assessed using the Apathy Evaluation Scale — Clinician version (AES) (Marin et al., 1991), and the Intrinsic Motivation factor score from the Quality of Life Scale (QLS) that consisted of the mean score for QLS items purpose, motivation, and curiosity (Heinrichs et al., 1984; Nakagami et al., 2008). Depressive symptoms were evaluated with the Calgary Depression Scale for Schizophrenia (CDSS) (Addington et al., 1990).

Effort exerted during cognitive testing was evaluated using the TOMM, a 50-item forced-choice visual object recognition task that

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