Eur. J. Psychiat. Vol. 24, N.° 4, (220-226)
2010

Keywords: Schizophrenia; Psychotherapy; Recovery; Narrative; Metacognition; Psychosis; Quality of life; Self.

Metacognition in schizophrenia spectrum disorders: Methods of assessment and associations with neurocognition and function

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ABSTRACT – *Background and Objectives:* Research has confirmed that many with schizophrenia experience deficits in metacognitive capacity defined as impairments in the ability to think about thinking, both with regards to their own thinking and the thinking of others. These difficulties are related to, but not reducible to symptoms. One question posed here regards how these deficits are linked to other forms of cognitive deficits, including deficits in neurocognition, and how they and other forms of cognitive deficits are related to the ability to function. As neurocognition is degraded in schizophrenia, does the ability to think about one's own thinking diminish? Do deficits in metacognition affect function in a manner semi-independent of deficits in neurocognition?

Methods: To explore these possibilities, this paper reviews recent studies of metacognition as assessed within personal narratives of self and illness spontaneously generated by adults with schizophrenia spectrum disorders.

Results: Studies are reviewed which suggest that impairments in verbal memory and executive function may interfere with the ability to form and sustain representation of one's own internal state as well as the internal states of others. Additionally, results are de-

tailed which suggest that metacognitive deficits directly affect function prospectively and may mediate the impact of neurocognitive deficits on functioning.

Conclusions: Results are consistent with the possibility that a certain level of neurocognition is needed to think about thinking in a complex manner and that the ability to think about thinking is intimately related to the ability to work and relate to others among persons with schizophrenia.

Received: 30 June 2010
Accepted: 21 July 2010

The term "Metacognition" refers to a general ability to think about one's own thinking. This capacity is thought to reflect a wide range of semi-independent faculties which allow individuals to form representations of their own mental states and the mental states of others; these representations enable one to form, challenge, and revise ideas of what is believed, felt, dreamt of, or feared in a number of rapidly evolving contexts[1]. Over the last two decades, research has suggested that deficits in metacognitive capacity are common in schizophrenia. Relative to those without psychosis, persons with schizophrenia have difficulties distinguishing the source of internal experiences, perceiving themselves as agents in the world, and detecting the intention and emotions of others from verbal and visual cues[2-7]. These deficits appear to be relatively stable over time and, while correlated with severity of psychopathology, are not simply a straightforward consequence of symptoms or other clinical features of schizophrenia[8-11].

The discovery of metacognitive deficits has led to interest in their relationships with other aspects of the disorder and with their potentially significant role in determining long term outcomes. In this paper we will first describe the development and psychometric properties of a novel method for assessing metacognition from personal narratives of self and illness. Next we will review recent studies exploring the link between metacognition, assessed using these procedures, with neurocognition, as well as its unique contribution to functional outcome, semi-independent of neurocognitive capacity.

Assessing metacognition with personal narratives

To date research on metacognition in schizophrenia has been hampered by a number of methodological issues. For one, most studies assess metacognition by measuring performance on a laboratory task which simulates social interaction or a self-reflective task, and so performance on these tests may not adequately capture the individual's ability to engage in metacognitive acts in day-to-day situations where the content may be emotion-laden and personally salient. Second, since laboratory-based tasks cue or call for specific metacognitive acts at specific times, these tasks may not measure how persons think and act spontaneously. Third, metacognition is often studied as a one-dimensional phenomenon while metacognitive acts may involve capacities that

are conceptually distinct and may involve semi-independent neurocognitive functions[12-14]. Accordingly, it might be overlooked that the capacity to perform different metacognitive acts are linked with separable neurocognitive functions and that as a result some persons may experience deficits in certain domains of metacognition but not others.

To measure metacognitive function as it might exist in emotionally salient tasks which do not cue for responses, we have proposed a method to rate metacognitive ability from a spontaneously generated speech sample about a person's own life story. That speech sample is obtained through a semi-structured interview called the Indiana Psychiatry Illness Interview (IPII). The IPII elicits a narrative about one's self and illness and typically lasts 30 to 60 minutes[15]. The IPII differs from other psychiatric interviews in that it produces a self-narrative in which specific metacognitive acts may appear spontaneously with minimal scaffolding by the interview's structure.

To quantify metacognitive capacity within IPII narratives, we have used a modified version of the *Metacognition Assessment Scale* (MAS)[16]. Originally designed to detect changes in metacognition within psychotherapy sessions for persons with severe personality disorders -, the MAS has been adapted for the study of IPII transcripts as part of a collaborative effort with the original authors[17]. The MAS contains four scales which pertain to different foci of metacognitive acts: "Self Reflectivity", or the comprehension of one's own mental states, "Understanding of others' minds", or the comprehension of others' mental states, "Decentration", or the ability to see others as having independent motives, and "Mastery", or the ability to use one's mental states to accomplish cognitive tasks or cope with psychological distress. Metacognitive capacity can vary along a continuum, and each of the four MAS subscales are accordingly broken down into an ordinal scale of increasing complexity. Thus, persons given higher rating on a certain MAS sub-scale are thought to be able to perform more complex acts of metacognition within that domain.

Evidence of good interrater reliability and internal consistency among the four MAS scales has been presented[18]. Concerning validity, MAS scores have been linked with assessments of insight, social cognition, coping preferences and self-reflectivity[17,19,20]. In one ongoing study, preliminary observations suggest that persons with schizophrenia experience graver deficits in metacognition as assessed within narratives compared to others with chronic medical conditions in the absence of psychosis.

Four studies: Neurocognition, metacognitive capacities and functional outcome

To study the relationship between neurocognition and metacognition, we first sought to determine whether ratings on the MAS were linked with performance on a range of neurocognitive tests[17]. Participants were 61 men with DSM-IV diagnoses of a schizophrenia spectrum disorder, recruited from an outpatient treatment setting. All were in a non-acute phase of illness and were not substance dependent.

Participants were administered the IPII along with a neurocognitive test battery which included the Wisconsin Card Sorting Test (WCST)[21], a test of abstract flexibility; the Hopkins Verbal Learning Test (HVLT)[22], an auditory verbal memory test; the Vocabulary subtest from the Wechsler Adult Intelligence Scale III (WAIS III)[23], a test of verbal intellectual function; the Digit Symbol sub-

test from the WAIS III which assesses processing speed; and the Visual Reproduction subtest of the Wechsler Memory Scale III (WMS III)[24]. Correlations revealed that greater capacity for Self-reflectivity was linked with better performance on the HVLT, Vocabulary and Digit Symbol subtest of the WAIS III, and the Visual Reproduction subtest of the WMS III. Greater capacities for Awareness of the other's mind and Mastery were correlated with better HVLT performance. The results of this study indicated that awareness of one's own thoughts and emotions is significantly linked with neurocognitive ability, and that other aspects of metacognition may depend on similar cognitive systems.

As a follow-up, a second study explored whether attaining certain levels of specific metacognitive function was dependent on possessing certain levels of neurocognition[28]. Accordingly, we compared the neurocognitive profiles of three different types of participants from a second sample: (i) those who had not achieved basic self-reflectivity, (ii) those with basic self-reflectivity but without decentration and (iii) those with both basic self-reflectivity and decentration. Basic self-reflectivity was defined as the ability to recognize one's own emotions while decentration was defined as the ability to see that others have independent relationships with one another.

Participants in this second sample were 61 adult men and 8 women with a diagnosis of a schizophrenia spectrum disorder, and were recruited from an outpatient treatment center. All were in a non-acute phase of illness. The neurocognitive test battery from the first study was utilized, plus the Block Design subtest from the WAIS III and the Arithmetic subtest from the WAIS III which taps working memory. From the WMS III, the Logical Memory subtest was added. Results revealed that participants classified as having at least basic self-reflectivity had better performance on the WCST and the WAIS III Arithmetic subtest. Participants with basic self-reflectivity who were also decentered had better performance on the Visual reproduction WMS III subtest.

In light of these findings it can be hypothesized that metacognitive deficits may also be linked to functional impairment; furthermore, this relationship may be independent of neurocognitive capacity. In support of this hypothesis, neurocognitive deficits have been widely observed to be predictive of poorer psychosocial functioning[25-26]. To explore this issue the next study tested the prediction that better metacognition is linked with better work performance over a period of six months[27]. Participants 56 adults in a post acute phase of illness enrolled in a work program which provided work placement. Work performance was assessed biweekly using the Work Behavior Inventory (WBI)[28]. Participants were classified on the basis of the MAS self reflectivity scores as: "High self-reflectivity" (aware of one's different emotions and the subjectivity of beliefs); "Medium self-reflectivity" (aware of one's different emotions but not the subjectivity of beliefs); and "Low self-reflectivity" (aware of neither one's different emotions or the subjectivity of beliefs). A repeated-measures ANOVA comparing the three groups on 13 biweekly work behavior inventory total scores revealed a significant effect of time with WBI scores generally increasing over course of the program, as well as a significant group effect with the high self-reflectivity group showing generally better work performance than either of the other two groups. A significant interaction was also observed suggesting the high self-reflectivity group improved faster and then sustained those gains relative to the other groups. When the repeated-measures ANOVA were performed again as an ANCOVA covarying for

WCST performance, the time, group and interaction effects remained significant.

Finally, in the last study we examined the same sample and asked whether metacognition mediates the impact of neurocognition upon indices of the quality and quantity of social relationships. Specifically, we used structural equation modeling to examine whether the Mastery domain of metacognition mediated the effects of neurocognition on the frequency of social contact and persons' capacity for social relatedness[29].

Participants were 102 adults with a schizophrenia spectrum disorder. Frequency and quality of social relationships was assessed using two subscales from the Quality of Life Scale: Interpersonal Relationships and Intrapsychic Foundations[30]. Neurocognitive function was represented by a factor score that resulted from a Principal Components Analysis on the basis of scores on the WCST, HVLT, WAIS III Vocabulary, WAIS Digit Symbol Subtest and WMS III visual reproduction. All assessments were obtained concurrently. To test the hypothesis that neurocognition influences capacity for mastery which then affects social function we used a measured-variable path analysis. This model revealed an acceptable fit to the observed data, which persisted after controlling for negative and cognitive symptoms. These results are consistent with the possibility metacognitive ability mediates the relationship between neurocognitive capacity and social function.

Summary, limitations and implications

In this paper we have described studies which have examined whether metacognitive capacity was related to neurocognition and to functional outcomes independent of neurocognition. Results of two studies were presented suggesting that better neurocognitive test performance is associated with better metacognitive performance. Results were then presented from two other studies suggesting that metacognitive function is linked to both work and psychosocial function in a manner that is semi-independent of neurocognition. In one of these studies evidence was found that metacognitive capacity mediates the impact of neurocognition upon function. While the correlational nature of these studies precludes drawing any firm conclusions, results are consistent with the possibility that a certain level of neurocognition is needed to think about thinking in a complex manner. Furthermore, the ability to think about thinking is intimately related to the ability to work and relate to others. Results of these studies are also consistent with findings using more laboratory based assessments of metacognition[8,11,31]. Rival hypotheses, however, cannot be ruled out.

Of note there are limitations. Generalization of findings is restricted by sample composition. Participants were mostly persons in their 40's, all of whom were involved in treatment. It may well be that a different relationship exists between neurocognition and metacognition among females, younger persons with schizophrenia, or persons who decline treatment. Additionally, thus far we have only examined a subset of the many possible aspects of metacognitive capacity in schizophrenia, and more study is necessary to explore a wider range of possible patterns of deficit among broader samples. Finally, results should not be taken to suggest that impairments in neurocognition are the only cause of deficits in metacognition. There is evidence that there are multiple paths which lead to deficits in metacognition among adults with severe mental illness[1].

Regarding the clinical implications of this work, if impairments in metacognition limit psychosocial and vocational function independently of neurocognition, it may be important to develop psychotherapeutic and rehabilitative interventions that support persons developing the ability to think about thinking. It may be that interventions which help persons develop self-reflectivity and mastery may open new opportunities for improved function.

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