

Metacognition in schizophrenia spectrum disorders: methods of assessing metacognition within narrative and links with neurocognition

Metacognizione nei disturbi dello spettro schizofrenico: metodi di valutazione della metacognizione all'interno della narrativa e collegamenti con la neurocognizione

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Summary

Research has confirmed that many people with schizophrenia experience deficits in metacognitive capacity, defined as impairments in the ability to think about thinking, both with regard to their own thinking and the thinking of others. These difficulties are related to, but not reducible to, symptoms and likely diminish quality of life by limiting the ability of a person with schizophrenia to construct consensually valid accounts of the meaning of daily events or the larger course of his or her life and psychiatric challenges. One possibility is that deficits in metacognitive capacity are linked to impairments in neurocognition. Perhaps as neurocognition is degraded during the early course of schizophrenia, the ability to think about one's own thinking and the thinking of others diminishes. To explore this possibility, this paper reviews recent studies of metacognition as assessed within personal narratives of self and illness spontaneously generated by adults with schizophrenia spectrum disorders. In these studies, metacognition within narratives was quantitatively assessed using the Metacognitive Assessment Scale and correlated with concurrent tests of neurocognition. Results are reported which suggest that impairments in verbal memory 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 detailed which suggest that distinguishing one's own internal states in schizophrenia may emerge when there are significant deficits in executive function. As a person has

greater difficulties maintaining flexibility between abstractions, he or she may have difficulties seeing oneself as experiencing complex internal states. Beyond this, the ability to see that others have their own unique views may be limited when one has impairments in visual memory. Clinical implications, limitations of these correlational studies and alternative explanations of findings are discussed.

Riassunto

La ricerca ha confermato che molte persone con schizofrenia esperiscono deficit nelle capacità metacognitive, definiti come compromissioni nella capacità di pensare del pensiero, sia per quanto riguarda il proprio pensiero che quello degli altri. Queste difficoltà sono legate, ma non riducibili a, sintomi e probabilmente riducono la qualità della vita attraverso la limitazione della capacità di una persona con schizofrenia di costruire resoconti consensualmente validi del significato di eventi quotidiani o del corso della propria esistenza e sollecitazioni psichiatriche in senso più ampio. Una possibilità è che i deficit di capacità metacognitive siano legati a compromissioni neurocognitive. Forse, poiché la neurocognizione viene degradata durante il primo corso della schizofrenia, la capacità di pensare del proprio pensiero e del pensiero degli altri diminuisce. Per esplorare questa possibilità, questo articolo prende in esame studi recenti sulla metacognizione valutata all'interno di narrative personali di sé e della propria malattia spontaneamente generati da pazienti

Key words

Schizophrenia spectrum disorders • *Metacognition (theory of mind)* • *Metacognitive Assessment Scale* • *Narrative* • *Visual memory* • *Verbal memory*

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adulti con disturbi dello spettro schizofrenico. In questi studi, la metacognizione nei narrati è stata valutata quantitativamente mediante la *Metacognitive Assessment Scale* e correlata con concomitanti test neurocognitivi. Vengono riportati risultati che suggeriscono che compromissioni della memoria verbale possono interferire con la capacità di formare e sostenere la rappresentazione del proprio stato interiore così come quello di altri. In aggiunta, vengono esposti in dettaglio risultati che suggeriscono che il distinguere i propri stati interni nella schizo-

frenia possa emergere quando vi sono deficit significativi nella funzione esecutiva. Poiché un soggetto ha maggiori difficoltà a mantenere la flessibilità tra astrazioni, può avere difficoltà a riconoscersi come persona che sperimenta complessi stati interiori. Al di là di questo, la capacità di riconoscere che gli altri hanno i loro particolari punti di vista può essere limitata quando si hanno danni nella memoria visiva. Vengono discusse le implicazioni cliniche e i limiti di questi studi correlazionali, nonché le spiegazioni alternative dei loro risultati.

Introduction

Metacognition refers to an individual's general capacity to think about his or her own thinking. This capacity is thought to reflect a general aptitude that involves a wide range of semi-independent faculties which allow the individual to perform discrete tasks such as forming representations of his or her own mental states and the mental states of others, and to form, question and revise ideas of what is believed, felt, dreamt of, feared, feigned or pretended in any of a number of rapidly evolving contexts. Metacognition refers both to implicit and explicit knowledge. It allows the individual to form and then accept or reject ideas about him or herself in the moment and also to sustain more enduring ideas about the kind of person he or she is across different situations. Metacognitive capacities consequently allow people to place disappointments and triumphs in a given perspective, to see growth from pain, opportunity in disappointment and to construct with others consensual meaning about daily activities.

Over the last 15 years, interest has grown rapidly in determining whether deficits in metacognitive capacity play a central role in the course and outcome of schizophrenia. It has been suggested that deficits in metacognition may be a risk factor for more severe levels of illness and prolonged dysfunction. One reason for initially thinking that schizophrenia might involve metacognitive deficits is that many of the symptoms of schizophrenia involve a failure to think about one's own thinking and to correct manifestly inaccurate conclusions about the motives of others and the origins of one's internal states. Delusional certainty that another

person wants to kill me because they are wearing an orange hat, which is linked to a conspiracy from Portugal, presumably may involve difficulties discerning the intentions and emotions of other persons as well as a failure to see my own thoughts are fallible. A lack of affect or volition could be linked to a failure to perceive myself as an active agent in the world or to be able to detect others' emotional responses. A second reason to think that metacognitive deficits may play an important part of an understanding of schizophrenia is that many with this condition are commonly unaware of their illness¹. They may also experience a reduced vitality of self-experience or feel that their core being or most personal sense of identity has been diminished². These unusual kinds of self-experience, which exist independent of symptoms, may also point to a loss of metacognitive capacity.

The overall question of whether schizophrenia is in part a disorder of metacognition, however, has import which reaches far beyond explaining symptoms. Understanding whether the loss of metacognitive capacity is a key feature of schizophrenia, as well as determining what factors contribute to that loss, could illuminate the processes that undermine function across the course of the illness. As a matter of intuition, reduced capacity to think about thinking should contribute to increased difficulty solving unexpected problems, especially for persons already faced with distressing symptoms and social stigma. With reduced self-awareness it could only be more trying to construct a meaningful picture of mental illness, making successful adaptation to that illness an even more distant possibility³. If I struggle to recognize the emotions

I feel, if I cannot see the conclusions that I have reached about myself and others as subjective and possibly inaccurate, how could I develop a working idea of my mental illness and chart a course towards wellness?

Indeed, research has confirmed that many with schizophrenia experience difficulties apprehending their own thoughts and the thoughts of others, and that such metacognitive deficits are not reducible to symptoms or other aspects of psychopathology⁴⁻⁷. One issue awaiting clarification, however, regards the factors that contribute to the development of metacognitive deficits. A nuanced understanding of the factors that contribute to compromises in different forms of metacognition could have important implications for clinical issues, ranging from prevention to remediation, as well as for emerging neurobiological models of social function.

In response to this question, this article will review our research concerning whether there are consistent patterns of association between metacognition in schizophrenia and one possible causal factor: impairments in neurocognitive function. To that end we will first review a rationale for why impairments in neurocognition may play a role in the development of deficits in metacognition. Next, we will describe limitations in the existing literature regarding the assessment of metacognition and our attempts to address these by rating different possible foci of metacognition within spontaneously generated personal narratives. Finally, we will survey the findings from a program of study aimed at uncovering the links between metacognitive capacity as revealed in those narratives and concurrent assessments of neurocognition.

Determinants of metacognition: the possible relationship of neurocognition and metacognition

Impairments in neurocognition are believed to appear early in the course of schizophrenia and include losses in previously held levels of ability to sustain attention, sort out relevant from irrelevant stimuli, recall and recognize visual or verbal material, and think in a flexible and abstract manner. The loss of these capacities has been widely suggested as limiting the ability to learn new material and to successfully solve problems⁸. As a result, persons with schizophrenia may quickly find it challenging to function in vocational and

interpersonal settings⁹. Tasks such as mastering new assignments on the job or managing conflicts with family may inexplicably become baffling and overwhelming.

Turning to the issue of explaining the development of deficits in metacognition, one possibility is that as neurocognitive abilities are degraded, there may be a point at which this imperils certain metacognitive acts. As noted above, performance on tests of neurocognition does not fully predict levels of metacognition nor explain the impact of deficits in metacognition on function¹⁰. Intact neurocognitive function is not necessarily sufficient for full metacognitive function; however, certain levels of neurocognitive function may be necessary to perform some basic metacognitive acts. Indirect evidence of this includes findings that more severe deficits in flexibility of abstract thought limit both social cognition¹¹ and the acquisition of social skills in rehabilitation¹². Other studies have more directly linked assessments of metacognition with performance on tests of verbal and visual memory¹³, visual memory span¹⁴, intelligence¹⁵, executive function^{13 16} and learning ability¹⁷ in schizophrenia.

The possibility that cognitive decline in schizophrenia could underpin some deficits in metacognition is also consistent with studies of other conditions. Following general cognitive loss many may experience familiar social situations as increasingly confusing and difficult to decode¹⁸. The loss of neurocognitive abilities as a result of head injury has also been suggested to lead to reduced ability to perform basic self-monitoring tasks¹⁹ and to shift mentally between different self-representations and sustain a functional sense of self²⁰. Asperger's syndrome, an inability to appreciate the thoughts and feelings of others, has been linked to difficulties both integrating contextual information, and to impairments in executive function which compromise persons' abilities to shift back and forth from two different viewpoints of the same event²¹. Also supporting this contention are studies of young children which suggest that executive functions emerge prior to, and are a basis for, the ability to think about the mental states of others²².

Limitations of current research on metacognition and neurocognition

While there is a solid basis for looking to neurocognitive impairments as a contributory factor to metacognitive deficits in schizophrenia, research

on this subject has been hampered to date by a range of different factors. For one, most studies have assessed metacognition by observing performance on a laboratory task which simulates social interaction or a self-reflective task. For instance, a participant might be asked to make a guess about someone's intention on the basis of a story or cartoon or to determine whether movements he or she was watching were mimicking the movement of his or her own arm^{4,23}. Yet, in daily life, metacognitive acts often occur in emotion-laden contexts or involve others for whom we have strong feelings. Thus, it may be objected that performance on tests using impersonal stimuli may not speak to persons' abilities to engage in metacognitive acts outside of the laboratory when sensitive personal issues are involved. A second problem is that these tasks cue or call for specific metacognitive acts at specific times, asking the participant to make an explicit judgment. Here the problem is that these tasks may be measuring how persons respond to cues for metacognition but not necessarily what they tend to do spontaneously. For instance, it might be possible that it is far more difficult to accurately judge an emotion a person is feeling without a cue to do so at a specific moment.

A third difficulty is that metacognition is often studied as a one-dimensional phenomenon. Metacognitive acts, however, which have different foci (thoughts about my own thinking vs. thoughts about another person's thinking) may involve capacities which are not only conceptually distinct but also involve semi-independent neurocognitive functions. For instance, metacognitive acts which involve making a judgment about oneself may be substantively different from metacognitive acts which involve deciding what another person is thinking. Research suggests that creating a mental image of myself may utilize a range of cortical activities, some of which are similar to those utilized when creating an image of another, but others which may be unique²⁴⁻²⁶. Thus, studying the larger problem of metacognition as varying along one axis carries the risk of missing the possibility that the capacity to perform metacognitive acts with different foci may, in part, be sustained by the activation of different brain areas. It is important to remember that it is possible that a capacity for successfully making metacognitive judgments in one or more metacognitive domains is unrelated to the capacity to make metacognitive judgments

in other domains (e.g., one may have an aptitude for discerning the emotions of others but have little sense of his or her own emotions).

The assessment of metacognition within narratives: the Indiana Psychiatry Illness Interview and Metacognition Assessment Scale

To address some of the difficulties associated with tasks that utilize cued responses or neutral stimuli, we have proposed a method to rate metacognition from a spontaneously generated speech sample. That speech sample is obtained through a semi-structured interview, the Indiana Psychiatry Illness Interview (IPII²⁷) which elicits a narrative of self and illness and typically lasts between 30 and 60 minutes. Responses are audio taped and later transcribed.

The IPII is divided conceptually into five sections. First, participants are asked to tell the story of their lives in as much detail as possible. Second, participants are asked if they think they have a mental illness and how they understand it. This is followed with questions about what has and has not been affected by their condition in terms of interpersonal, vocational, and psychological life. In the third section, participants are asked if their condition "controls" their life and if and how well they "control" their condition. Fourth, participants are asked how much their illness is affected by others and how much others have been affected by their illness. Finally, participants are asked what they expect to stay the same and what they expect to change in the future, again in terms of interpersonal and psychological function.

The IPII differs from other psychiatric interviews in that the interviewer is instructed not to introduce content. Interviewers do not ask participants about symptoms, for instance, whether they hear or see things other people do not hear or see. The interviewer may ask for minor clarification when confused and also may query non-directively; however he or she may not pose questions about specific matters nor ask for historical details to anchor the story. The IPII thus results in a self-narrative in which specific metacognitive acts may appear spontaneously. As a life story is told, there are a number of potentially emotion-laden turns in that story where participants may choose or not choose to think about their own thinking, the thinking of others, or how certain challenges are best faced.

Furthermore, because a larger story is being told which includes the individual person, other people in relation to him or her as well as others in relation to each other, it also is a sample in which different kinds of metacognitive capacity can be separately estimated.

To assess metacognition within IPII narratives, we have used an abbreviated version of the Metacognition Assessment Scale (MAS²⁸). The MAS is a rating scale that assesses metacognitive abilities as manifest in an individual's verbalizations. It was originally designed to detect within psychotherapy transcripts changes in the ability of persons with severe personality disorders to think about their own thinking. In consultation with the original authors, the MAS has been adapted for the study of IPII transcripts²⁹.

The MAS contains four scales which pertain to different foci of metacognitive acts: "Understanding of one's own mind" or the comprehension of one's own mental states, "Understanding of others' minds" or the comprehension of other individuals' mental states, "Decentration" or the ability to see the world as existing with others having independent motives, and "Mastery" or the ability to work through one's representations and mental states to implement effective action strategies in order to accomplish cognitive tasks or cope with problematic mental states. Individuals are assumed to possess capacities in each of these domains which vary along a continuum. Accordingly, each of the four MAS subscales are broken down into a series of steps which are arranged in order of increasing complexity. Thus, once a step is not attained, no higher steps on that scale should be able to be obtained. For example, awareness of one's own mind is divided into nine steps. If one does not recognize one's emotions, for instance (step four out of a total of nine), then it should not be possible to obtain the next step, which is to understand links between one's thoughts and feelings (step five out of a total of nine).

To assess narratives using the MAS, the rater looks for evidence of the steps within each scale. If evidence is found that the capacity to perform a specific step is present, a point is awarded and the rater then searches for evidence that the participant can perform the next step. If no evidence is found that the participant is capable of performing the metacognitive act described in the next step, no evidence is sought for the subsequent higher capacities and the

score for that scale is the number of steps already achieved. As an example, after a rater has judged that a participant had achieved the first three steps of the MAS Understanding of One's Own Mind scale, the rater would turn to the next step within this scale: awareness of one's own emotions. To do this the rater would search the IPII transcript for places where the participant described different ways he or she felt. If the rater then found several places in the transcript where the participant described his or her own emotions, this would constitute evidence that the participant was able to identify his or her own emotions and a point would be awarded. The rater would then start to search for evidence of the next step: awareness that one's views of the world are fallible. If the next step was rated as achieved another point would be awarded (giving the subject 5 points so far) and the rater would search for evidence of the sixth step. Once a rater determines there is no evidence of a capacity to perform a step no further steps are considered and the final score is the number of steps the participant was judged to be capable of performing. In this way, increasing scores reflect increasingly complex metacognitive operations. A final score of "5" for a given scale would reflect more complex levels of metacognition in this domain than a "4," but less complex metacognition than a "6".

Evidence of the reliability of these methods for quantitatively assessing metacognition includes findings of good interrater reliability for blind raters separately assessing the same narratives and internal consistency among the four MAS scales³⁰. Concerning its validity, MAS scores have been linked with Amador and colleagues' 1 Scale to Assess Unawareness of Mental Disorder, which is a measure of the ability to evaluate one's own mental illness²⁹. Regarding convergent and divergent validity performance of the MAS, MAS scores have been found to be correlated with performance on the Scale to Assess Narrative Development, which measures depth of personal narrative, while being uncorrelated with theoretically unrelated aspects of self-experience such as internalized stigma³¹. In a study submitted for publication³², we have found MAS scores linked with assessment of social cognition using the Social Cognition and Object Relations Scale³³, a scale which allows for assessments based on responses to The Thematic Apperception Test³⁴, which measures the extent to which persons construct a complex story about social interactions.

Three studies: neurocognition and metacognitive capacities as assessed with personal narratives

To study the possible relationship of neurocognitive and metacognitive capacities, we have undertaken a series of studies in which we have concurrently gathered IPII narratives and assessments of neurocognition from adults with schizophrenia entering rehabilitation. The purpose of these studies has been to search for associations between the metacognitive capacities assessed with the MAS and different forms of neurocognitive capacities. Results of these studies and their implications will be detailed in the next section.

Study 1

In our first study²⁹ we sought to determine whether ratings on three of the domains assessed by the MAS were linked with performance on a range of neurocognitive functions. Our central questions were: do poorer levels of metacognitive functions assessed within narratives of persons with schizophrenia correlate with poorer neurocognitive test performance, and if so, do certain types of metacognitive deficits have unique links with poorer performance on certain types of neurocognitive tests? Participants were 61 men with DSM-IV diagnoses of schizophrenia ($n = 40$) or schizoaffective disorder ($n = 21$) enrolled in a larger study seeking to develop a cognitive behavioral therapy targeting working function in schizophrenia. All were initially recruited from the outpatient Psychiatry Service of a VA Medical Center in the Midwestern United States and were in a post-acute phase of illness as defined by having no hospitalizations or changes in medication or housing, in the month prior to entering the study.

Participants were administered the IPII along with a battery of neurocognitive tests which included the Wisconsin Card Sorting Test (WCST³⁵). The WCST assesses flexibility in abstract thought by presenting the participant with a problem which requires them to form an idea about how to solve that problem, hold onto that solution and shift to another solution when the first solution no longer successfully solves the problem. Two commonly generated scores are: 1) the total number of categories correct, which reflects the number of times the participant was able to grasp the key idea and then shift to another idea when necessary and 2)

the number of persevering responses, or times a participant could not flexibly shift to another idea. The second test of the battery was the Hopkins Verbal Learning Test (HVL³⁶), an auditory verbal memory test which presents participants with a list of words they are asked to repeat back and then later to recognize. The HVL³⁶ score used for this study was the total number of correctly recalled words across all trials.

The third group of neurocognitive tests gathered were from the Wechsler Adult Intelligence Scale III (WAIS III³⁷), the most widely used assessment of intellectual function. From this test we used two subscales: Vocabulary, which assesses participants' global verbal intellectual function (and is believed to tap pre-morbid intelligence in schizophrenia) and the Digit Symbol subtest which assesses processing speed. Finally, we also assessed visual memory using the Visual Reproduction subtest of the Wechsler Memory Scale III (WMS III³⁸).

To assess the relation of metacognition and neurocognition, we next correlated MAS scores for Awareness of one's own mind, Awareness of other's mind and Mastery. Results revealed that participants rated as having a greater metacognitive capacity for awareness of one's own mind had better performance on the HVL³⁶, the Vocabulary and Digit Symbol subtest of the WAIS III, and the Visual Reproduction subtest of the WMS III. When entered into a regression, the Vocabulary and Digit Symbol scores predicted a quarter of the variance in Understanding of one's own mind. Participants rated as having greater metacognitive capacities for knowing the other's mind and for mastery tended to have better performance on the HVL³⁶. No measures were related to the WCST.

We concluded that these results can be taken to suggest that deficits in metacognition about one's own mental states may be influenced by possible risk factors for schizophrenia, such as pre-morbid intellectual function and cognitive impairments linked to the disease progress, such as processing speed. The finding that verbal memory was linked with all three domains may suggest that these deficits also interfere with the ability to form and hold onto a mental representation of internal states as objects for contemplation. Perhaps with greater difficulty encoding verbal material it may be more difficult to maintain the larger cognitive structures needed to make meaning of experience and frame a personal sense of self.

Study 2

To follow up on these findings, we conducted a second study exploring whether possessing certain levels of specific metacognitive function was related to also having certain levels of neurocognition³⁰. Here the question was: do certain elements of metacognition require minimal levels of neurocognitive function? To respond to this issue, we studied the MAS ratings of a second sample of adults with schizophrenia enrolled in rehabilitation. In particular, we divided our sample into groups based on whether they had achieved basic self-reflectivity and basic decentration and then compared their performance on neurocognitive tests.

Participants in this second IPIL sample were 61 adult men and 8 women with diagnoses of schizophrenia ($n=43$) or schizoaffective disorder ($n=26$). All were recruited from the outpatient Psychiatry Service of a VA Medical Center or Community Mental Health Center and were in a post-acute phase of illness according to the same definition as in Study 1. The neurocognitive test battery differed from the first study in that we utilized more subtests of the WAIS III, including not only Vocabulary and Digit Symbol but also the Block Design subtest, which assesses visual spatial processing and is often used as a non-verbal measure of intelligence. The Arithmetic subtest, also included in the test battery for Study 2, calls on persons to mentally manipulate numbers in order to solve mathematical problems; for this reason, it is understood to involve working memory. From the WMS III, we again used the Visual Reproduction subtest and this time the Logical Memory subtest, a test of verbal memory in which participants hear stories and are then asked to recall as many different units of meaning from those stories. As before, we included the WCST.

To divide participants into those who possessed vs. did not possess basic self-reflectivity and decentration, we used the Understanding of one's own mind scale (with a range of 0-9) and the Decentration scale (with a range of 0-3) of the MAS. Participants were rated on an a priori basis as having basic self-reflective capacity if they obtained scores of "4" or higher and as not having basic self-reflectivity if they scored lower than "4" on the MAS Understanding of one's own mind scale. They were rated on an a priori basis as having achieved decentration if they achieved a score of "2" or higher and as not having achieved decentration if they achieved scores of less than "2" on

the MAS Decentration scale. This resulted in participants being placed into three groups:

1. minimal self-reflectivity/not decentered ($n = 25$);
2. basic self-reflectivity/not decentered ($n = 33$); and
3. basic self-reflectivity/decentered ($n = 11$).

There were no participants, as expected, who were decentered but who lacked basic self-reflectivity.

The three groups were then compared on background variables and neurocognitive testing and were not found to differ according to diagnosis or other demographic information. Comparisons of test scores between the three groups revealed that participants with basic self-reflectivity had generally better performance on the WCST and the WAIS III Arithmetic subtest, while participants rated as having achieved basic decentration had better performance on the Visual reproduction subtest of the WMS III. The basic self-reflectivity/decentered group also had better performance on the Vocabulary and Block Design subtest than the minimal reflectivity group.

We interpreted these results as suggesting that difficulties distinguishing internal states in schizophrenia can emerge when there are significant deficits in executive function, such as those present in persons who have greater difficulties holding abstract matters in mind and shifting fluidly between such concepts. Beyond this, whereas flexibility in abstract thought may aid in self-awareness, the ability to see that others have their own unique views requires relatively intact visual memory, perhaps to be able to represent social relations in a complex spatial manner. Such assertions are consistent with Frith and de Vignemont's²¹ observation that egocentrism in Asperger's syndrome may result from an inability to form representations of others as having a relation to one another which is fully independent of the individual's relationship to others.

Study 3

In our third study³⁹, we planned to follow up our previous findings linking absence of full self-awareness with deficits in executive function. One of the limitations of the previous study is that it assessed executive function exclusively using the WCST. Though a reasonable measure of global executive function, the WCST is widely seen as unable to distinguish between the multiple and semi-independent elements of executive function⁴⁰.

Success at the task, for instance, requires a range of different capacities, including the ability to form an idea, then to inhibit that idea and shift to another. Thus, it is unclear whether specific aspects of executive function are more closely linked than others to different forms of metacognition. This seems to be especially important because of all the neurocognitive capacities studied so far, executive function, at least, intuitively seems likely to play a significant role in the construction of a complex and flexible idea of the self.

To address this issue, we examined whether MAS scores were linked with selected subtests of the Delis Kaplan Executive Function System (DKEFS⁴¹). The DKEFS assesses multiple domains of executive function, potentially relevant for metacognitive acts including i) tests of inhibition and set shifting – the ability to willfully inhibit a thought or feeling and switch to another in a goal directed manner and ii) mental flexibility – the ability to form and reform ideas about how different stimuli can be related to one another in a goal-directed manner⁴². In this study, we chose six specific DKEFS subtests, three because of their links to inhibition switching (i.e. tests which require making responses according to alternating principles) and three because of their links with mental flexibility (i.e. tests which require moving between abstractions to solve problems). The inhibition switching tests we considered were:

1. design fluency switching – how many different designs can be generated on a piece of paper by alternately connecting dots that are filled in with dots that are open;
2. category-switching on *Verbal Fluency Task* – how many words from alternating categories can be produced verbally in 60 seconds;
3. inhibition-switching from the *Color-Word Task* – the capacity to alternately name the color of the ink a word is printed in (which spells out a different color) and then read the word ignoring the color it is printed in. The tasks requiring mental flexibility we chose were;
4. total correct sorts from the *Sorting Task* – the number of different ways participants arrange cards into two groups based on the cards' attributes;
5. total score for the *Word Context Task* – how quickly the meaning of nonsense words are grasped from increasingly precise contextual hints;
6. the total correct score of the *Twenty Questions*

Test – how many “yes/no” questions it takes for a participant to correctly identify an object chosen by the examiner from a picture of an array of objects.

This sample consisted of 49 participants drawn from the first two IPII studies above, based on whether they completed the DKEFS as part of a study of the correlates of anxiety and the IPII as part of one of the first two studies. For this reason it is notable that the DKEFS and MAS were not administered concurrently and could have taken place potentially up to 6 months apart (something likely to attenuate our findings but not to bias us to find spurious correlations).

Two specific analyses were undertaken. First, Spearman Rho correlations were calculated between the six DKEFS scores and the MAS Understanding one's own mind, Understanding the other's mind, Mastery and Total score. These revealed that achieving greater levels of Understanding one's own mind was linked to better performance on the Sorting, Word Context, and Twenty Questions tests. Also, attaining higher levels of Understanding the others' mind was linked to better performance on the Design Fluency Switching and Twenty Questions tests. Greater Mastery was linked to better performance on the Verbal Fluency Switching and Twenty Questions tests.

Since the MAS Decentration scores showed a skewed range, with 76% of the sample having a score of “1” or less, in our second analysis we treated this as a categorical variable; we classified participants as having high Decentration if their Decentration scores were greater than “1” or low Decentration if the scores were “1” or less. Scores of greater than “1” suggest the ability to see the world as involving others' unique thoughts and feelings. An ANOVA was then conducted comparing the DKEFS scores of participants with high (n = 7) vs. low (n = 42). Results revealed that participants with higher levels of Decentration had significantly higher scores on the Verbal Fluency, Color Word Switching, and Word Context tests.

The pattern of results may suggest that awareness of one's own mind is more closely linked to mental flexibility than the other domains assessed by the MAS. The DKEFS tests linked to the ability to inhibit a response were more closely linked to Decentration and somewhat linked to Awareness of the other's mind and Mastery. While causality cannot be determined in any of the cross-sectional designs we

have employed, results are at least consistent with the possibility that as persons with schizophrenia are less able to move flexibly between abstract ideas, they cannot detect the nuances and different patterns present in how they think and feel. They might be less able, for instance, to see how a feeling of anger could be reframed as sadness or vulnerability, and also how those feelings of anger are like the feelings anger they have felt in some past situations but not others. Without being able to define thoughts and feelings in multiple ways, awareness of internal complexity may be difficult to sustain. Results also support the speculation that with a reduced capacity to inhibit one's immediate thoughts or reactions, preoccupation with one's own needs may serve as a barrier to recognizing the needs of others. Without an ability to inhibit thoughts about one's own needs, some may find it difficult to call to mind the perspectives of others and to detect a range of different meanings in rapidly evolving but ambiguous situations.

Summary, limitations and conclusions

In sum, there are many reasons to believe that impairments in neurocognition may play a role in the development of metacognitive deficits in schizophrenia. In this article we have described three studies which have examined whether the capacity to spontaneously perform different kinds of metacognitive acts while talking about one's life story was linked to concurrent performance on neurocognitive tests. Results suggested that better performance on tests of neurocognition was linked to better performance on a range of measures of metacognition. Specific findings were suggestive of the possibility that certain levels of neurocognitive capacity are necessary for successfully performing certain metacognitive acts. For instance, awareness of one's own thoughts and feelings, and the ability to plausibly frame psychological challenges and respond with a meaningful coping response may both require a certain level of executive function. Seeing that others have independent relationships with one another may require intact visual memory and the ability to employ more complex coping strategies may require relatively less impairment in processing speed.

As commented above several times, the correlational nature of each of these studies precludes drawing any firm conclusions and all interpreta-

tions of the observed relationships are intended as speculative and a possible basis for hypotheses for future study. Furthermore, there are alternative hypotheses that cannot be ruled out. It is possible that different neurocognitive deficits in schizophrenia are in part the result of different forms of metacognitive deficits. Perhaps different metacognitive dysfunctions interact with each other to generate neurocognitive dysfunctions or possibly deficits in neurocognition and metacognition magnify one another in a cyclical manner.

Generalization of findings also is limited 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 younger persons with schizophrenia, or in particular, persons who decline treatment. We additionally examined only several of many possible aspects of metacognitive capacity in schizophrenia and more study is called for to explore a wider range of possible patterns of deficit. Thus, more research is necessary which involves the collection of data exploring other aspects of neurocognition and metacognition at multiple time points using broader samples. Finally, results should not be taken to suggest that impairments in neurocognition are the only or even main causal force in the development of deficits in metacognition. There is much evidence that there are multiple paths which lead to deficits in metacognition among adults with severe mental illness; at best, neurocognitive impairment plays a role along with many other forces.

Regarding the clinical implications of this work, it seems worth noting that if impairments in different aspects of neurocognition are linked to decrements in certain metacognitive acts, then interventions might be thought of as necessary to assist persons to perform neurocognitive tasks which are intrinsically difficult for them (e.g. flexibly shifting set or processing information quickly), in order to better think about their own thinking. This, at the very least, may point to the possibility of the development of psychotherapeutic and rehabilitative interventions that support persons learning to perform neurocognitive tasks linked to specific aspects of metacognition. If impairments, for instance, in the ability to shift set (the act of forming an abstract idea about a set of events and then changing that idea when dealing with the next set of events), are

linked to problems discerning one's own thoughts and feelings, then interventions which help persons to recognize that they are applying the same abstractions to different internal states, might lead to deeper self-understanding.

Of note, implied in these speculations is that cognitive impairments in schizophrenia are likely to be persistent barriers to the engagement in metacognitive acts. However, this is certainly an empirical question, and one that has yet to be tested. Another issue to be examined is the question of what happens if neurocognitive deficits are remediated. Would the remediation of neurocognitive impairments⁴³ automatically lead to improved metacognition? These and many other questions await longitudinal research.

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