The metacognitive functioning in schizophrenia: a proposal for assessment

Il funzionamento metacognitivo della schizofrenia: proposta di valutazione

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Summary

Several studies have highlighted many metacognitive deficits in patients with schizophrenia.
The concept of metacognition refers to all those abilities that are needed to understand one's own or someone else's thoughts and affections, and refers also to the process of reflection on mental states that allows to use such information to solve psychological or interpersonal conflicts. Thus, metacognition includes a series of semi-independent abilities that could be damaged separately or in combination. Due to the multi-dimensional nature of the construct, in this survey we suggest a battery of tests, each test analyses different metacognitive functions. Furthermore, we propose an implementation of such battery through the presentation of results of two groups of patients with schizophrenia (characterized by different levels of inveteracy), and the comparison with a control group composed of healthy subjects. The implementation of this battery has highlighted the presence of metacognitive impairments from the early onset of the disease, while the comparison between chronic patients and patients at the early onset of the disease shows a gradual impairment of such abilities.

Key words

Schizophrenia • Assessment • Hinting Test • Brüne Picture Sequencing Task • Reading the Mind in the Eyes test • Irony Task • Beck Cognitive Insight Scale

Metacognition in schizophrenia

During the last decades several studies have highlighted the presence of an impairment about specific abilities defined "metacognitive" [1-5]. In literature, the term "metacognition" coincides with other terms such as Theory of Mind (ToM) [6-10], social cognition [11], emotional awareness deficit or alexithymia [12-15], mentalization [16 17] and affective awareness [18]. The "metacognition" concept refers to the general ability of each individual to infer one's own and others' thoughts and affections and to the process of reflection on mental states that allows to use such representation in order to solve psychological and interpersonal conflicts [19-21]. Thus, metacognition includes a series of semi-independent abilities that could be damaged separately or in combination; for example, we can infer others' emotions through their facial expressions, but we have less sensitivity towards our own emotions. These metacognitive skills, not only can be activated separately but they also interact among them functioning like a system able to allow social adaptation and problem solving.
Patients with schizophrenia have strong metacognitive impairments: they have difficulty in distinguishing the origin of their inner experience; in perceiving themselves as able to actively affect what is happening around them; when they are involved in relationships they cannot understand others' implied intentions and emotions through visual and verbal signals, they are not able to build elaborate descriptions of themselves and others, as well as understanding their irony; and normally their speeches are characterized by poverty of contents and confusion [1 4 5 22-26]. Metacognitive impairments are a constitutive part of the disease [1] and they play a fundamental role for the onset and the maintenance of the disease [27 28]; they have a direct effect on social functioning, because they affect the abilities to engage in relationships and in social skills, in taking care of oneself and in keeping a working activity [29-34]; in general they agree to undertake the treatment [35].
These impairments seem to be a distinguishing feature of the disease, that is quite stable over the time [36] and they can be sharpened by the early onset of dysfunctional emotions and beliefs [37 38]. Due to the main role played by the metacognitive functioning within the schizophrenic disease, in this survey we are going to provide a battery of tests selected to assess such functioning; we did believe that a metacognition assessment must be considered for the definition of complex projects such as in the case of the so called difficult patients [39].

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Assessment of the metacognitive functioning

Despite the growing interest in the metacognition role during the last years, there is no agreement so far about which test can be considered the most suitable to evaluate such abilities. In schizophrenia metacognition is mainly studied in terms of ToM, showing a relevant correlation between ToM impairments and specific symptoms, for example the persecutory delusion [2 40-44].

Due to the multi-dimensional nature of metacognition, during its assessment it is better to include multiple tasks or tests to analyse the different functions. Some of these tests require that the subject makes some reasoning about others' mental states. Such tests are called "social-cognitive" and require the assimilation of contextual aspects about individuals (for example what some specific characters know and what they did, in order to infer their mental state) and they interact with other complex cognitive functions, like the language.

Some of these tasks assess the comprehension of others' mental states using vignettes or pictures sequencing [45 46]. These tests assess the subject's ability to infer the false beliefs of one of the characters of the story, or the false beliefs that a character of the story has about another character's mental state. In order to succeed in such tasks it is necessary for the subject to distinguish mental states and mental representations from the real world. Other similar tools demand the subject to complete stories where he has to infer the characters' intentions (AIT) [47]. Among the social-cognition tools, there are those that assess the subject's ability to understand the pragmatic language, in other words the ability to infer the meaning of others' speeches (for example tests that assess irony or the ability to understand metaphors). A good pragmatic skill implies the ability of going beyond the literal meaning of words to infer and evaluate the speaker's beliefs and intentions. Schizophrenic patients have problems in understanding both irony and metaphor use.

A second category of ToM tasks is the *social-perception* one; these tests investigate the patient's ability to infer mental states through implicit signals (for example by facial expressions or by the observation of bodily movements), and also using one's own automatic affective system. Probably the best know among these, is the Eyes Test [7 48] with which subjects are requested to choose which mental state best describes the photographs of the eye region they have been shown; schizophrenic subjects perform worse than healthy subjects [49].

Metacognition in schizophrenia has often been studied as a one-dimensional phenomenon, but the metacognitive acts have different sources and could involve skills that are conceptually separate [50]; as we have seen, the ability to understand one's own and others' mental state, among these there are the simplest skills, like the one that allows to understand the others' emotional expressions, or some others more elaborate, like the one that allows to keep a continuous representation of oneself in an integrated way. Therefore it is better to introduce multiple tasks to assess metacognitive abilities. Thus, during the assessment, it is necessary to use a series of tools that take into account the complexity of the metacognition construct.

Starting from these premises we have chosen some assessment tools, that were selected to answer to patient's needs as well as to the examiner's, within a clinic context like the schizophrenic one. Indeed, tests should not be onerous in terms of time and commitment, both for the patient (burdened by symptoms and by cognitive impairments during the performance) and for the examiner (normally a Services operator with heavy burden of work). We believe it is necessary to use a battery of tests and not only a single test, just because of the multi-dimensional nature of the metacognitive functioning; also to limit the methodological error due to the patients' heterogeneity of function: many of them shows different abilities in answering to verbal tests rather than iconic tests. Therefore, it is important to have the possibility to diversify the stimulus proposed with the test, in order to obtain a more complex evaluation, closer to that of the actual functioning. We suggest a battery of tests to assess the different metacognitive functions, that could be also easy to administrate, and that could be used with other tools, in order to observe how such functions interact with aspects that are closely correlated, like the social functioning, the subjectively perceived quality of life and the symptomatology aspects; so to have a "customized" definition of the complex treatment course of the schizophrenic patient.

The selected tests are the following. Two social-cognitive tasks have been selected to assess ToM abilities and the understanding of others' mental states, these tasks solicit such functions using different stimuli: *The Hinting Task* (pragmatic language comprehension) and the *Theory of Mind Picture Sequencing Task* (stories with picture sequencing). A social-perceptive task like the *Reading the Mind in the Eyes test* to assess the ability to understand others' emotions. We have also added a test like the *Irony Task*, to assess the abilities to infer others' intentions, and a self-report scale like the *Beck Cognitive Insight Scale*, to assess the self-reflection.

The tests

The *Hinting Task* [41] is a test that consists of 10 brief stories describing an interaction between two characters. Each story ends with one character giving a hint and the

participants have to infer the intention hidden behind the speeches; they are brief stories, in order to reduce the interference of memory or verbal comprehension problems. For example, story 10 is the following: Patricia is getting off the train with three heavy suitcases. John is standing behind her. Patricia says to John "Wow, these suitcases are a bother!". Each story is read aloud by the evaluator to the patient and they can be read as many times as needed to assure a correct understanding of them. At the end of each story the evaluator drops an easy and clear comment about the main character of the story. This is a useful hint for the subject who has to answer to the evaluator's question about the character's intentions. Regarding the story above for example, the evaluator will ask: "What does Patricia really want to say when she says this?". If the subject answers correctly 2 points are given, otherwise the evaluator makes a second comment to make the scenario clearer for the subject, and makes again the question; for example he could suggest "Patricia continues to say – I don't know if I can manage all 3 of them" and then he asks "What does Patricia want John to do?". If the subject answers correctly 1 point is given, if the answer is incorrect or he/she cannot answer, the score is 0. The task has a maximum score of 20 points and healthy adults normally reach the maximum score. The test administration normally takes from 5 to 15 minutes.

The *Theory of Mind Picture Sequencing Task* (PST) is a test developed by Brüne [46] to assess the relation between intelligence and ToM abilities in schizophrenia. During this test the patient is asked to put in the right sequence some vignettes that describe a story. There are 6 stories, each one consists of 4 pictures to be put in order by the patient in a logical sequence as fast as possible. Two stories describe a scenario were two characters cooperate, other two stories describe a scenario where one character deceives a second character; the last two stories describe a scenario where two characters cooperate to deceive a third. For example in the story of the apple tree, there is a boy who is trying to get an apple from a tree, while another boy is reading, the first boy cannot get the apple and asks the second to help him, they manage to get the apple and in the last picture they eat it together. Then the examiner makes some questions to evaluate the patient's ability to infer the mental states of each character of the stories; questions will concern levels of understanding, levels of growing complexity, first and second order false belief; tasks about cheating detection and questions about reality. For example, about the apple tree story, it is asked "What does the person with the red shirt believe the one in blue shirt intends to do?" to evaluate the second order beliefs, or " What does the person with the red shirt expect from the person in the blue shirt?" to evaluate the patient's ability to understand the reciprocity in the scene. If subjects fail to put in the right order the stories, the examiner will put the pictures into the correct order before making other questions. For the correct order of the pictures and for the answers, will be given a score whose maximum value is 59 points.

The *Irony task* [51] is a test that consists of 63 vignettes: 31 pictures where it is necessary to ascribe ignorance, false belief or deception to one of the character, thus analysing his/her mental state in order to understand

TABLE I.
Mean and standard deviation of the three groups. *Media e deviazione standard dei tre gruppi.*

	CONTROL		ONSET		CHRONIC	
	Mean	SD	Mean	SD	Mean	SD
Age	29.22	6.77	23.57	2.27	34.14	5.17
Hinting	19.61	0.50	17.57	2.56	13.21	5.11
PST P	57.61	2.03	51.00	6.59	42.86	10.57
PST T	119.5	26.96	209.21	94.00	257.21	72.2
Irony P	23.22	2.92	19.00	8.19	11.21	6.85
Irony T	460.11	128.86	663.57	344.31	866.79	225.53
Irony H	2.16	0.45	2.66	0.59	3.63	0.22
Irony D	1.95	0.42	2.12	0.56	2.67	0.69
Eyes test	28.5	2.68	24.57	3.95	21.5	5.41

Hinting: Hinting Task Total score; PST P: Theory of Mind Picture Sequencing Task Total score; PST T: Theory of Mind Picture Sequencing Task Total time; Irony P: Irony Task Total score; Irony T: Irony Task Total score; Irony H: Irony Task Degree of fun; Irony D: Irony Task Degree of difficulty; Eyes Test: *Reading the Mind in the Eyes* Total score.

irony (ToM vignettes). The remaining 32 vignettes describe physical events or behaviours that do not need ToM abilities to be correctly understood. Subjects are requested to observe each vignette and to indicate to the examiner its meaning as soon as they will understand it. Later the subjects give their own brief explanation of the meaning of the vignette itself. The examiner records with a timer the time the subject needs to explain the vignette. If the explanation is correct 1 point is given, 0 points if is incorrect. The explanation is considered correct only if a suitable mental state is ascribed to one or more characters. An objective score is obtained from the total of the correct answers. It is also requested to give a subjective score (from 1 to 5) about the degree of fun and the degree of difficulty to understand each vignette. We chose 30 of the 63 humorous vignettes (15 ToM + 15 Physical) in order to shorten the times of test administration.

The *Reading the Mind in the Eyes* or *Adult Eyes Test* [48] is a test that considers the eyes as the part of the face mainly involved in expressing complex emotions. In this test are shown 36 pictures with different set of eyes, to each set of eyes are ascribed 4 adjectives and the subject has to choose the one that best describes what the person in the picture is thinking or feeling. This test was useful to understand and evaluate the subject ability to put himself in the other's mind, tuning in with his/her mental state.

The *Beck Cognitive Insight Scale* [52] evaluates patients' self-reflectiveness according to their experiences, the self-certainty and the ability to self-correct their own wrong judgements. It consists of a 15-item self-report questionnaire, divided into two sub-scales. The first subscale consists of 9 items about self-reflectiveness, it evaluates subject's objectivity, reflectiveness and openness to feedback. The second sub-scale instead consists of 6 items measuring decision making, high degree of certainty in one's interpretations: for example it assesses the "Jumping to conclusions", certainty of being right and resistance to corrections. The subject is asked to give an answer to each question on a 4-point scale, from 0 (do not agree at all) to 3 (agree completely). The test had no time limit. Detracting the second sub-scale from the first one, we have a composite index, the BCIS, that reflects the degree of the cognitive insight, in other words the introspective ability and the capacity to understand one's own errors.

An example of clinic application

In order to evaluate the sensitivity and specificity feature of the battery of tests, we have administered the different tests to two groups, each one composed of 15 patients of the DSM clinics of the ASL RMD; they were all diagnosed within the schizophrenia spectrum, diagnosis made according to DSM IV-TR criteria by psychiatrists specialized in the treatment of such diseases. The first group was composed of young patients at their first crisis, with less than 3-5 years of disease (mean age: 23 years old); the second group of chronic patients with more than 5 years of disease (mean age: 34 years old). Such partition was made according to Birchwood's hypothesis, who identified in the first 3-5 years of disease the so called "critical period", when the main social and personal impairments are developed, with the resulting loss of self-esteem, relationships and competence at school and at work. The tested patients are all males, except for one girl of the first group. All of them, at the moment of the test, were in stable clinical conditions and benefited of the same services offered by the ASL RMD, including pharmacological, clinical, and rehabilitative treatment. Patients with mental retard, cranial trauma, neurological disorders, epilepsy, substance misuse at the moment and for more than 6 months, were excluded. The outcomes for both the clinical groups were compared to those of a control group composed of 15 healthy male subjects, all the selected tests were administered to them.

The aim is to evaluate the quality of the battery, to understand the differences in ToM ability according to a heterogeneous population like the schizophrenic one, that shows an impairment in such skill. These ToM impairments indeed are already present in the subjects at their very first episode and tend to become more serious and pervasive during the years, damaging in this way the social functioning.

At a first examination of the mean and standard deviations of the scores resulting from the several tests it appears clear the general tendency to impairment for both the samples; if we compare them with the results obtained from the test previously administered to a sample of healthy subjects with an age that ranges from 20 to 40, we can see that the clinical samples have worse scores compared to the healthy ones, and at the same time, they need more time to carry out the tasks, if we consider for example the time measurement for *Brüne*'s and Irony tests. It seems that patients try to balance their performance (that is still problematic) taking more time to give an answer.

Later on, we have evaluated the significance of differences between the performance made by the subjects of the clinical samples using the one way ANOVA with the Tukey Post hoc test and with significance < 0.05 (Tab. II). From the data obtained it appears as the worst functioning in chronic patients compared to the control group, is more significant in all the tests that have been administered, contrary to what happens in the early onset group, where there were no significant differences in the Hint-

TABLE II.
Turkey Post Hoc. *Turkey Post Hoc*.

Variabile	Sample (I)	Sample (J)	Mean Difference (I-J)	Sig
Hinting	Control	Onset	2.040	.178
		Chronic	6.397	.000
	Onset	Chronic	4.357	.002
PST T	Control	Onset	-89.714	.002
		Chronic	-137.714	.000
	Onset	Chronic	-48.00	.155
PST P	Control	Onset	6.611	.029
		Chronic	14.754	.000
	Onset	Chronic	8.143	.010
Irony P	Control	Onset	4.22	.144
		Chronic	12.008	.000
	Onset	Chronic	7.786	.005
Irony D	Control	Onset	-.167	.680
		Chronic	-.725	.002
	Onset	Chronic	-.557	.031
Irony H	Control	Onset	-.495	.010
		Chronic	-1.038	.000
	Onset	Chronic	-5.428	.008
Eyes test	Control	Onset	3.929	.025
		Chronic	7.000	.000
	Onset	Chronic	3.071	.124

Hinting: Hinting Task Total score; PST P: Theory of Mind Picture Sequencing Task Total score; PST T: Theory of Mind Picture Sequencing Task Total time; Irony P: Irony Task Total score; Irony T: Irony Task Total score; Irony H: Irony Task Degree of fun; Irony D: Irony Task Degree of difficulty; Eyes Test: *Reading the Mind in the Eyes* Total score.

ing and in the Irony test. The different seriousness of ToM abilities impairment for the two clinical samples appears even if we compare them; effectively there were statistically significant differences in *Brüne*, Irony (except for the time) and Hinting tests.

Discussion

There is widespread agreement in literature, about the central role played by the metacognitive deficit in causing the social functioning impairment in serious psychiatric disorders particularly in schizophrenia [34]. Patients diagnosed within the schizophrenia spectrum show an overall deficit of metacognitive functions [1 2 5]. These observations call for the need to integrate in the assessment routine of such patients a specific protocol of evaluation for this area. In this study we have presented a battery of tests that has to evaluate the metacognitive functioning of these patients using a multi dimensional perspective; only the use of different tools allows to understand and measure the multi dimensional complexity of such functions [58].

The implementation of this battery have highlighted the presence of metacognition impairments since the early years of the disease, the comparison between the chronic patients and others at the early onset, showed a gradual impairment of such abilities. The differences between the group of chronic and the subjects at the early onset of the disease, are indeed significant, except for the Eye test and for the times obtained in the Irony test. The outcomes can be surely generalized, because of the small number of subjects of the different groups, but they allow us to make some hypothesis for this pilot study:

- it is necessary to evaluate the metacognitive functions through a wide battery of tests, contrary to what many studies carried out until now; tasks that consider the different aspects of metacognition, not only the specific ToM ability;

- instead of classifying metacognitive dysfunctions simply as present or absent, as state or trait markers, it could be more interesting and therapeutically significant to evaluate the gradual impairment, keeping in mind that some metacognitive areas could be impaired at the beginning but not yet significantly altered.

The proposed battery, besides showing a good sensitivity in noticing the presence of an impairment, it also answers to the need to evaluate metacognition under a multidimensional perspective. Both the social cognitive tasks (that analyse the ability to understand the mental states of others) and the social perceptual tasks (that evaluate the implicit mental states decoding) were adopted; and a classic test "paper and pencil" has been added as a self-report questionnaire.

With the *Theory of Mind Picture Sequencing Task* (that is a task about false belief and deception) some vignettes are used to infer false beliefs belonging to one of the character of the story and the false beliefs of one character about the mental state of another. Tests like the *Irony task* and the *Hinting Task*, instead assess the pragmatic skill of the patient, in other words the ability of going beyond the literal meaning of words to infer and evaluate the speaker's beliefs and communicative intentions, even in a conversational context. Among the "social perceptual" tests there is the *Reading the Mind in the Eyes* that allows to infer mental states from the visual expression, using both the theory of mind abilities and the identification of the most basic emotions. We considered only a self-report tool, the *Beck Cognitive Insight Scale*, that evaluates the subjects' self-reflectiveness.

The decision to use tests that assess the different functions, using different types of tasks, allow to reduce, at least in part, what we consider to be the main limit of the battery, in other words these are evaluations carried out in "clinic", in an environment that is not emotionally stimulating. In a future perspective we would like to integrate tools that can give suggestions about the patients' capacity to "mentalize in the field"; even patients that seem to be capable, when they are evaluated with specific testing assessment, can show difficulties in metacognitive functioning, such difficulties make them less efficient and less fast when they have to interact in the dynamic structure of everyday life.

Conflict of interests

The authors declare that there are no conflicts of interest. The authors have not received grants.

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