

The Theory of Mind (ToM): theoretical, neurobiological and clinical profiles

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Abstract

The concept of "Theory of Mind" (ToM) is defined as the cognitive ability to represent one's own and others' mental states, in terms of thoughts and beliefs, but also of desires, demands and feelings, so that one can explain and predict behaviour. In this work the theoretical profiles, the main reference models, the related neurobiological and clinical profiles are analysed, orienting future research on the question whether or not it is interesting to further investigate the theoretical aspects under examination, such as empathy and the perception of the self and the other in relation to the neurobiological components, to draw a common line able to connect the loss of these functions with the accentuation or the onset of certain pathologies, wondering whether it is the functional compromises of these capacities and functions that cause the psychopathological condition to arise or whether it is rather the disease that induces the dysfunctional modification of these capacities or functions.

Keywords: Theory of Mind; theoretical; neurogenetic

Contents of the manuscript:

1. The General Concept of the "Theory of Mind"

The concept of "Theory of Mind" (ToM) is defined as the cognitive ability to represent one's own and others' mental states, in terms of thoughts and beliefs, but also of desires, demands and feelings, so that one can explain and predict behaviour. It therefore seems correct to affirm that the Theory of Mind is a cognitive capacity innate in the human being, whose development process, however, is also influenced in part by the socio-cultural context of the subject, regardless of his intellectual level [1-2].

The Theory of the Mind is therefore a default capacity in humans that allows each person to interpret the signals of the social environment and their own emotions, thus reinforcing beliefs about reality, extracting from time to time the meaning sought (and wanted), in a subjective and arbitrary way, sometimes adhering to the external objective reality, very often the opposite. [3] Such operations, however, also make it possible to distinguish between reality and fiction (and the pretending of/that...), and therefore, if developed, also to recognise lies, false beliefs, to understand metaphors, irony and so-called "faux pas" situations (the so-called gaffes). [1]

2. The theoretical reference models

Historically, the expression "Theory of Mind" was coined by Premack and Woodruff in the article "Does the chimpanzee have a Theory of Mind?", in which the ability of chimpanzees to predict the behaviour of a human actor

in purposeful situations is investigated. These researchers used the term ToM to refer to the ability to understand a mental state of another organism based on the analysis of its behaviour. It has been hypothesized, from an evolutionary point of view, that a Theory of the Mind of self and others emerged in the evolution of hominids as an adaptive response to a more complex social environment. It is no coincidence, in fact, that individuals with good mind reading skills would be more capable than others in social relations, thus having greater reproductive success. However, while primates and great apes are considered experts in reading behaviour, gestures, intention of movements and facial expressions, the ability to read the mind and cognitively represent one's own mind and that of others, i.e. the "fullness" of the Theory of Mind, does not necessarily depend on environmental sensory input. [4] In fact, an individual can think what others have in mind, even without seeing them. [5] However, the contrary viewpoint of other authors who do not agree with the statement that monkeys have a ToM. [6]

The development of the Theory of Mind branches out into a few fundamental stages, which several authors have identified and developed, in its complex theoretical articulation:

- 1) Tomasello [7] maintains that the initial capacity at the basis of development, as well as the foundation of the understanding of mental phenomena, is the understanding of intentionality. This ability, in healthy subjects, appears at a very early age, around the year of life, when the child begins to direct his or her attention to the intentional dimension of actions, rather than the mechanical one. This attention to intentionality is demonstrated by the fact that children, intent on imitating a behaviour, almost immediately begin to adjust to the objective of their actions, losing interest in a faithful repetition of the observed behavioural sequences. At two to three years of age the child is able to understand non-epistemic mental states (such as desires, emotions, intentions) and fictional games (for example: pretend that two fingers are a telephone or a gun), while, around the age of four, the full development of the Theory of Mind is achieved, with the ability to understand epistemic mental states and to predict the behaviour of others based on information about the other one, having reached the ability to read the mind of others; finally, at twelve-thirteen months from birth the child is able to recognise and distinguish facial expressions and their emotional meaning.
- 2) Main and Fonagy [8-10] related the development of mental state representation skills to the quality of the child's attachment relationship with the caregivers. According to Fonagy, a good reflective capacity in the caregiver increases the likelihood that the child will establish a secure attachment to the caregiver(s) and develop an adequate capacity for mentalisation. A secure attachment relationship offers the child the opportunity to explore the caregiver's mind and, in this way, to learn to read other people's mental states. If the child does not develop a secure attachment, there will be a vulnerability of the subject to the development of psychic suffering, as well as possibilities for the development of frankly psychopathological forms of attachment.
- 3) Baron-Cohen [11-13] argue that the development of the individual is organised around the progressive biological maturation of brain structures, based on genetically determined phases. Within this genetic-biological current, however, there are some authors who admit that, in certain phenotypic expressions, aspects of interaction with the environment are involved.
- 4) Carpendale and Lewis [14] support a position certainly oriented in favour of the role of social interactions, in which the child is formed not by himself but mainly by progressively learning from interactions with the reference adults in the first instance, and with the peer group in the second instance.

Within the Theory of Mind, however, three main and distinct theoretical models have been elaborated, on which most of the studies have been concentrated: [15-17]

- 1) Theory-Theory theorists, Gopnik and Wellman, suggest that mental activity is based on knowledge comparable to that contained in a scientific theory and that the child acquires different levels of representational abilities during development. By learning to discriminate real situations from hypothetical ones, he builds a theory of the Theory of Mind which allows him to infer other people's mental representations in order to build his own understanding of the mental world, just as a scientist develops a theoretical system for understanding the world. The so-called mental representations have been defined as meta-representations. Unlike the next model (Modular Theory), this approach attributes a greater role in the formation of the skill of Mind Theory to individual experience, which provides tools for reviewing and reorganizing knowledge.
- 2) The theorists of the "Modular" approach, unlike the previous one, support the innatistic thesis using the concept of "modularity" as it is related to Fodor's hypothesis on the "modular mind", according to not necessarily involve conscious reflection, but can easily be brought back to a plane of consciousness. Conscious reflection on one's own and others' mental states requires computational resources that go beyond the ability to simulate or imitate an action and the candidate structure for this purpose is

which the human mind is made up of specialised modules, genetically determined and functioning autonomously. Scholl and Leslie, in this theme, proposed the existence of a separate Mind Theory module (ToM-Module), with the specific function of processing information related to social inference. Moreover, they suggested that the correct functioning of the ToM-Module depends on a "selection processor", able to separate relevant contextual information from irrelevant information, thus increasing the probability of a correct inference of other people's mental states. The development of this ability would depend mainly on the neurological maturation of the brain structures involved, while experience would induce its use.

- 3) The theorists of the "Simulation Theory" approach, including Goldman, believe that mental activity is based on non-theoretical experience and propose that possessing a Theory of Mind is a quality linked to the ability to put oneself in the other's shoes. Inferring other people's mental states would consist in simulating the world in the perspective of the other, experiencing mental states "as if...", replicating them, without necessarily trying or sharing them. This approach also underlines the importance of experience in the formation of Theory of Mind skills. A recent empirical support has been provided by the observation that monkeys and humans possess so-called mirror neurons, brain cells that have the particularity of being activated during the observation of gestures involving hands and mouth. Welsh and Goldman have hypothesized that the ability to read other people's mental states has evolved from the mirror neuron system of primates.

3. The neurobiological basis

Starting with research on primates, many scholars have wondered what areas of the brain are involved in the Theory of Mind. Investigations in this regard have been carried out in different fields. Comparative studies of neuroanatomy and neurophysiology have provided information about which areas of the brain and which corresponding functions have evolved as neural correlates in the Theory of Mind. In addition, studies of functional neuroimaging and brain injury studies can help to locate the brain circuits underlying the Theory of Mind. [1, 18]

In the primate brain, many areas have been identified that have undergone adaptive modifications during the course of evolution, which have then become in man the neural network underlying the Theory of Mind. Studies of macaques have revealed that neurons in the central portion of the temporal lobe, particularly in the posterior temporal fissure (STS), selectively ignite when monkeys observe the direction of other monkeys' gaze. These neurons are also activated when animals observe a direct action for a purpose. [17] Functional imaging studies have revealed that observation of movements of inanimate objects that appear to have a purpose (as opposed to random movements) in humans causes activation of a homologous area of the temporal lobe. The same happens when movement is implicit in the observation of a photograph; therefore, the activity of parts of the STS is linked to the observation of intentional movements. [19]

The temporal lobe also contains a particular type of neurons, called mirror neurons because of their unique quality of discharge both during the execution of a hand or mouth movement and during the simple observation of the same movement made by another person. The discovery of mirror neurons in humans has offered an explanation of how the ability to imitate the actions of others may have evolved into the ability to simulate the mental states of others [20]. However, as Frith [21-22] pointed out, for the Theory of Mind it is not enough to represent actions directed to a purpose, but it is also necessary to know how to distinguish between behaviours generated by oneself or by others. The ability to simulate the mental states of others does the lower parietal cortex. And in particular the right inferior parietal cortex would seem to be important to consciously represent the mental states of others, while the left inferior parietal cortex could be involved in the representation of one's own mental states. [23]

Recent fMRI studies show, however, that ToM can be dissociated from other cognitive functions and that this performance is linked to a specialised socio-cognitive brain network, which includes the medial prefrontal cortex and cingulate cortex (MPFC), posterior cingulate cortex and bilateral temporoparietal regions [24].

The variability of results, often contradictory, in the different tasks aimed at assessing the Theory of Mind, suggests that these tasks involve different processes. If, for example, the performance of false beliefs requires a cognitive understanding of the difference between what the speaker knows and what the listener knows, the tasks of irony and faux pas also require an empathic understanding of the listener's emotional state. The Theory of Mind would thus be formed by two sub-sections: affective aspects and cognitive aspects. A similar distinction between these two aspects was suggested by Brothers and Ring [25], who distinguished between "hot" and "cold" aspects of the Theory of Mind. With the concept of cognitive ToM we mean, therefore, the ability to recognise the mental state of the other in terms of thought and with affective ToM the ability to recognise the mental state in terms of emotion (which in literature is often defined as empathy). Studies on patients with localised ventromedial prefrontal damage have provided evidence for the dissociation between affective and cognitive aspects of Theory of Mind. In fact, it has been reported that patients with lesions in this area have poor performance in tasks assessing affective ToM (faux pas and irony), but not in tasks involving cognitive ToM (second order beliefs). Furthermore, patients' performances in tasks of affective ToM are positively correlated with their empathic abilities, indicating that the ability to make affective representations of the other's mental state is associated with the ability to be empathic [26]. From these results it has been hypothesized that the behavioural deficits of individuals with localized ventromedial damage could be attributed to an affective ToM deficit, rather than to a generalized Mind Theory deficit.

4. Neuropathological and psychopathological profiles

The direct compromise of the Theory of Mind is found in different clinical pictures through a wide range of behavioural anomalies. Specifically in psychopathological conditions such as:

- 1) "Spectrum of autistic disorders" [11-13, 27-29]: in it is evident a specific deficit in the understanding of beliefs as psychological causes of behaviour, which is not due to language difficulties, ignorance of causality or inability to sequencing. Leslie and Frith then showed that autistic children had very poor results in rearranging cartoons that required understanding of belief, while they had no difficulty in sequencing stories about a character's wishes or aims. Since this cognitive defect had been present since birth, it was assumed that these children did not develop a Theory of Mind at all. Underlying this disorder would be the lack of development of the meta-representational mechanism underlying the construction of a Theory of the Mind.
- 2) "Schizophrenia" [27, 30-42]: it is one of the pathologies that show a Deficit Theory of the Deficit Mind and that has awakened more interest in recent years. Regarding the comparison between the mentalisation of autistic people and schizophrenics, Frith suggests a distinction: if the cognitive defect of autism is present in children from birth and, consequently, the overall course of their development will be abnormal, in schizophrenic patients it arises as an effect of psychotic onset, although they may have shown signs of social abnormalities already during childhood. The literature of the last fifteen years has been very interested in assessing and understanding the Mind Theory deficit in schizophrenic patients. Again according to Frith's model, the main characteristic of the processes of mentalisation is the ability to reason about how we represent the world, our thoughts and actions. This characteristic is called meta-representation and is the basis of self-awareness. The model under examination identifies at least three types of meta-representation deficits in people suffering from schizophrenia:

a) disturbance of awareness of one's goals: it corresponds to the difficulty of moving and speaking intentionally and of intentionally manifesting feelings. In particular, the negative symptoms would be due to the inability to produce intentional actions and the positive ones to the inability to inhibit inappropriate behaviour. b) Disorder of awareness of one's own intentions: it is represented by the person's perception that their actions are not caused by themselves, but by external forces. This is at the basis of delusions of influence, intrusive thoughts and auditory hallucinations, i.e. the perception of one's own thoughts or of sub-vocal language experienced as foreign to oneself. c) Disturbance of the awareness of others' intentions: it leads to the production of wrong inferences about the intentions of others. There is the appearance of reference delusions (people erroneously perceive by others the will to communicate with them), delusions of persecution (people erroneously perceive by others the will to attack them), inconsistent language (inability to correctly provide information on the topics under discussion) and auditory hallucinations in the third person (information erroneously perceived as coming from an external source). One of the crucial questions in scientific research on the Theory of Mind in schizophrenia is whether the deficits in this faculty are specific or whether they are a consequence of a more general cognitive impairment of attention, executive functions, memory or intelligence. In fact, it is well known that social functioning is extremely influenced by basic cognitive deficits and how a strengthening of these areas also modifies relational aspects. The Mind Theory deficit seems to be specific. In fact, there is consistent evidence that it cannot be explained either by the presence of psychopathology or by a compromise of executive functions or by a general cognitive impairment. The heterogeneity of the symptomatology typical of schizophrenic pathology means that, even when some studies find evidence of ToM impairment, it is not possible to identify specific symptoms, or clusters of symptoms, with which the deficit itself is associated; probably in schizophrenic subjects different symptoms may be linked to different deficits in mentalisation abilities. Finally, research in recent years on the non-verbal behaviour of schizophrenic patients has shown that this type of patient can be significantly distinguished from non-affected subjects on the basis of reduced expressiveness. For example: microanalytical studies of facial movements using the Facial Action Coding System (FACS) have revealed that schizophrenic patients have reduced facial expressivity. Taking into account, on the one hand, the association between non-verbal expressivity and social cognition and, on the other hand, the link between social cognition and social competence in schizophrenia, it is possible that the reduction in prosocial expressivity of patients is associated with their poor understanding of other people's mental states. Brune's study is interested in answering the question whether the reduced non-verbal expressiveness in social communication (prosocial behaviour) of schizophrenic patients can be linked to poor social competence and the difficulty of understanding other people's mental states. Therefore, this study starts from the hypothesis that patients suffering from schizophrenia differ from healthy controls in terms of non-verbal expressivity and neurocognition (social and non social) and that, having poor prosocial behaviour, they show reduced social skills in interactions and poor socio-cognitive skills, compared to patients with unaltered non-verbal expressivity. On the other hand, they are not necessarily expected to differ from healthy controls compared to other neurocognitive (non-social) domains. In line with previous studies, reduced non-verbal expressivity was found in patients compared to healthy controls during an evaluation interview. As expected, patients were also less able than controls to understand other people's mental states. In addition, patients with greater difficulty in Mind Theory showed not only more behavioural abnormalities, but also reduced non-verbal expressiveness, which normally serves to facilitate interaction. This study shows that patients with lower levels of non-verbal expressivity have a worse performance in the tasks of false beliefs, when compared to patients whose non-verbal expressivity was found to be normal during the

evaluation interview. Significant differences were also found between patients with high and low prosocial behaviour with respect to aspects of psychopathology and social skills. These results show, as already mentioned, that the mentalisation deficit is the best predictor of poor social competence and has a greater power of explanation than executive functioning or IQ. The causes of reduced non-verbal expressiveness in schizophrenic patients are not yet completely clear. The most simplistic explanation is that it is a direct consequence of the severity of negative symptoms, and this would be partially consistent with the conclusions of this study. However, the greatest negative correlation was found between non-verbal expressivity and cognitive disorganisation, and not with the level of negative symptoms. Furthermore, previous studies have shown that mentalisation is more deficient in patients with disorganised symptoms. It is therefore possible that poor Mind Theory skills contribute to the reduced use of non-verbal expressivity in patients.

- 3) "Symptoms related to frontal lobe lesions". [43]
- 4) "Human dementia". [44-46, 74]
- 5) "Bipolar disorder". [47-48]
- 6) "Normal and functional ageing". [49]
- 7) "Personality Disorders". [50] Mentalisation difficulties during therapy have been found in most people with personality disorders, primarily with a diagnosis of borderline personality disorder. Bateman and Fonagy believe that a traumatic life event can produce a partial temporary collapse of interpersonal interpretative function and they advance empirical and clinical evidence to confirm this hypothesis. The ability to mentalise is compromised in a significant percentage of individuals who have experienced trauma, especially in childhood (it was not possible to develop a secure attachment with the caregiver). Bateman and Fonagy also argue that borderline patients who have experienced child abuse will defensively avoid having a thought about their own and others' mental states, as this knowledge has cost them an unbearable amount of suffering during the experience of abuse. The collapse of mentalisation in the face of trauma leads to a partial loss of awareness of the relationship between internal and external reality. When one loses the ability to mentalise, finally, one observes the reappearance of those modes of perception of psychic reality that preceded the conquest of this ability in normal development.

5. The use of standardised tests to get to know ToM

The gold standard of testing to assess the understanding of other people's mental states is the "false-belief task", frequently used to assess Mind Theory during the developmental period, in autism and schizophrenia. It consists of testing a subject's ability to understand that others may have false beliefs about an event of which they have a correct knowledge. It is used to assess both first order false beliefs (the subject must infer inference about a situation by predicting the mental state of another person performing an action) and second order beliefs (which test the understanding of another person's beliefs relative to those of a third person). [51]

The classic Sally and Anne Test experimentally creates a situation in which the subject has to distinguish between knowing that an object has been hidden by one of the two characters (Anne) in the absence of the other (Sally) and the fact that one of the two characters (Sally) does not have this knowledge. Children under four years of age usually have a bad performance, because in order to respond adequately it is necessary to possess the capacity of meta-representation of mental states. The Sally and Anne Test was born as a test to investigate false first order beliefs, but has been extended to second order beliefs. [52] In order to understand higher order false beliefs (e.g. irony, metaphors, faux pas) we need more sophisticated cognitive capacities of Theory of the Mind. It has been shown that to understand metaphors one needs at least the understanding of the first order beliefs of Theory of the Mind, while for irony one also needs the understanding of second order beliefs, because this process is connected with the ability to go beyond the literal meaning and to infer what the speaker

really wants to understand. With adults with psychopathological conditions, various visual material has been used (for example: cartoons representing simple stories containing bluff, innocent lies, gaffes, misunderstandings, faux pas, irony) to test the skills of Theory of Mind. [53] Another paradigm employed is the so-called deception task. Also in this case it is possible to distinguish first and second order stories. This deception detection task consists in presenting the patient with a story in which one character provides another with incorrect information (and then tries to manipulate his beliefs and the resulting actions) in order to achieve his own goal. The test subject must explain why the character has provided the other with incorrect information. In second order stories, however, the character ignores the information received because he or she knows that the other is trying to deceive him or her. Like the false-belief task, the discriminating validity of the second-order deception task is better than that of the first-order tasks. In addition, Baron-Choen [11-13] have developed a more realistic test, the Eye Test, in which the subjects' task is to infer the mental state of others by observing the eye region, which is only depicted. This test is designed for the evaluation of the emotional ToM.

A last example is the Theory Of Mind Picture Sequencing Task [54-56], which uses 6 stories, each one composed of 4 cartoons to be rearranged. There are 3 types of stories:

- 1) a scenario in which two characters cooperate;
 - 2) a scenario in which one character cheats another;
 - 3) a scenario in which two characters cooperate to cheat another character.
- The vignettes are presented covered and in a scattered order. The subject examined is asked to discover and rearrange them in the shortest possible time to form a sequence of events that makes logical sense. For each story the reorder time is calculated and 2 points are awarded if the first and fourth cards are in correct order and 1 point if the second and third cards are correct (reorder score). Moreover, the subject has to answer some questions that aim to evaluate the understanding of the mental states, of different complexity, of the characters in the stories. Among these questions there are some that act as control items, because they involve only the generalized ability to process physical information (reality questions). The results consist of the reordering time, the total reordering score and the number of correct answers to the questions. A total score with a maximum of 59 points is given (the total reordering score is a maximum of 36 and the score to questions 23). Specifically, the variables considered in this study are:
- a) Understanding First Order False Beliefs: recognition that a character has a false belief in the world;
 - b) Understanding of Second Order False Beliefs: understanding of the false beliefs of one character on the belief of another character;
 - c) Understanding of Third Order False Beliefs: understanding of a character's belief in another character's false belief in his belief;
 - d) Understanding Reality: it is the physical reality of things, what happens in reality (control question);
 - e) Understanding Reciprocity: Reciprocity is waiting for an expectation of ours (for example, in terms of a material reward) to be fulfilled by another individual of whom we know something;
 - f) Understanding Deception: understanding of the intention of one character to deceive another (involves a First Order Theory of Mind);
 - g) Understanding of Deception Detection: understanding of the intention of one character to deceive another (involves a second-order Theory of Mind);
 - h) Average scores of the answers to the questionnaire: average of all the scores of the questionnaire composed of questions of Mind Theory;
 - i) Average reordering: average of the 6 reordering scores of the cartoons.

6. The relationship between ToM and social cognition

The Theory of Mind is currently considered as a part of the broader concept of social cognition, even more evident in schizophrenic patients. In fact,

having difficulties in different domains of social functioning, such as communication, interpersonal relationships, family and work roles, is typical of schizophrenic patients. It has recently been hypothesized that ToM impairment is a trait that is present both in schizophrenic patients and in relatives not suffering from psychosis. As already mentioned, social behaviour includes different integrated skills such as Mind Theory, perception of social signals, recognition of facial expressions, attention, memory, decision making and motivation. Many of these components of social cognition are deficient in schizophrenic patients. However, research in the field of social cognition and Mind Theory still presents many points that have not been sufficiently investigated. One issue concerns the fact that, while for patients the test deficits result in social cognition deficits and real difficulties in everyday life, for non-affected relatives this is not the case and, in most cases, they are in the normal range. Furthermore, the question whether ToM's task performance is an independent function or rather reflects a dysfunction of other cognitive abilities, such as attention, memory and global intelligence, is still a matter of debate. Consequently, impairment in social cognition could also be affected for relatives by impairment in neuropsychological performance, which would affect the skills to be tested. [57]

7. Rehabilitation treatments for dysfunctional and pathological aspects

The profiles under examination concern pharmacological, technical and instrumental approaches. [1] In particular:

- 1) In psychiatric patients [59], the need for association with individual or group psychotherapy [58] also "pharmacological therapy" becomes an essential necessity from the concrete case under examination, in order to better manage the patient's symptomatological picture [60-73], without ever excluding the two opportunities.
- 2) The use of video-recorded material to evaluate mental states, especially in schizophrenic subjects, appears functional and interesting from a rehabilitation perspective. In fact, Kayser's study uses videos specifically chosen to focus on the training of Mind Theory skills. The material consists of twelve short scenes extrapolated from films, representing interactions between two or more characters. The different mental states present in the various clips include: beliefs,

8. Relationships with other functions and capabilities. Conclusive profiles

The Theory of Mind (ToM), understood as the cognitive capacity to represent one's own and others' mental states (in terms of thoughts and beliefs, but also of desires, requests and feelings) in such a way as to explain and predict behaviour, is part of a framework of psychological functionality together with metacognition and emotions. [1] The new directions in ToM studies (concerning psychopathological and neuroscientific research) provide us with a further possibility to connect ToM to metacognition and emotions.

It is not by chance that the numerous studies mentioned in this work highlight the importance of intersubjective exchange, underlining the importance of the caregiver [81] for the development of ToM, without underestimating the active role that also the child and, subsequently, other adults play in relationships, except for the psychopathological relationships already identified and analysed, directly and indirectly. [82]

In the near future it could be interesting to further investigate the theoretical aspects under examination, such as empathy and the perception of the self and the other in relation to neurobiological components, in order to draw a common line able to connect the loss of these functions with the accentuation or the onset of certain pathologies, wondering if it is the functional compromises of these capacities and functions that cause the psychopathological condition to arise or if it is rather the disease that induces the dysfunctional modification of these capacities or functions.

disappointment, surprise, hostility, irony and misunderstanding. Only scenes were chosen in which the characters' intentions were clearly identifiable and understandable independently of the entire film. Each video lasted between twenty and seventy seconds and could be viewed several times, depending on the need reported by the patients. During each session the clinician tries to draw attention to the general context of each scene and then move on to the analysis of the characters' behaviour and intentionality. Each hypothesis is discussed by the whole group and the clinician simply has a guiding and moderating role. Participants are encouraged to reflect on the intentionality of the characters, in order to make hypotheses and support them with appropriate evidence. Each session lasts approximately one hour and includes the analysis of six scenes. This study is based on the hypothesis that training in Mind Theory induces a direct improvement in the ability to infer other people's mental states, communication skills and disorganisation and indirect improvement in general symptomatology. In fact, in the evaluation carried out at the end of the training, patients showed less signs of disorganization and improvements in communication skills and attribution of intentionality to others. This result confirms that the inability to attribute mental states to others, typical of schizophrenia, is to be considered, at least in part, remedial, and this should stimulate further research in this field. On the other hand, however, no improvement in the general symptomatology was found at the end of the training. Surely the short training period is the greatest limit for the observation of changes in the overall state of the patient. [75-76]

- 3) There are also alternative rehabilitation techniques that focus more on the cognitive deficit mechanisms underlying the perception and interpretation of environmental signals, such as Metacognitive Training which is based on two fundamental components: knowledge translation (where cognitive bias and their relationship with schizophrenic pathology are explained) and the demonstration of the negative consequences of cognitive bias (consisting of exercises focused on individual cognitive bias). Patients are taught to recognise and counter bias through the use of alternative strategies that will help them to arrive at appropriate inferences by dodging "cognitive traps". [77-80]

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