

Studi sperimentali

Theory of Mind and social functioning in schizophrenia: correlation with figurative language abnormalities, clinical symptoms and general intelligence

Teoria della Mente e funzionamento sociale nella schizofrenia: correlazione con anomalie del linguaggio figurato, sintomatologia clinica e intelligenza generale

CRISTIANO PIOVAN¹, LAURA GAVA¹, MARA CAMPEOL¹

E-mail: cristiano.piovan@sanita.padova.it

¹Mental Health Department, Psychiatric Clinic, Padua, Italy

SUMMARY. Aim. Over past few decades, studies displayed Theory of Mind (ToM) as a system, including cognitive and affective features, rather than an unitary process. Within domains defining social cognition, ToM stands for the best predictor of poor social functioning in schizophrenia. The current study aimed to explore competence in ToM tasks, in metaphorical and idiomatic language identification tasks and in a conversational rules observance test, as well as relationship with social functioning, in a group of outpatients suffering from schizophrenia. **Methods.** 30 outpatients diagnosed with schizophrenia and 24 healthy subjects have been recruited. Both groups underwent TIB as premorbid IQ evaluation, PANSS, Theory of Mind Picture Sequencing Task, a metaphors and idiomatic expressions comprehension test and a conversational test. Social functioning was assessed with PSP. **Results.** Mean values of premorbid IQ showed no significant difference between patients and control group. In ToM and pragmatic competence tasks, differences between groups resulted in high significance, due to patients' lower performance. A correlation between metaphors and idiomatic expressions comprehension and second order false beliefs was detected. PSP showed a correlation with PANSS and cognitive-ToM, whereas leaving aside affective-ToM. **Conclusions.** Results showed how people affected with schizophrenia, in stable clinical condition, do have clear impairments in ToM and figurative language comprehension assignments. In our theoretical framework, correlation arisen between cognitive-ToM, pragmatic deficits, clinical status and social functioning level suggests usefulness of rehabilitative interventions to recover metacognitive functions and pragmatic abilities, in order to reduce social disability in schizophrenia.

KEY WORDS: theory of mind, schizophrenia, metaphors, idioms, conversational rules, symptoms and social functioning.

RIASSUNTO. Scopo. Negli ultimi decenni gli studi hanno mostrato come la Teoria della Mente (ToM) non sia un processo unitario, ma un sistema che include aspetti cognitivi e affettivi. Nell'ambito dei domini che definiscono la social cognition, la ToM rappresenta il miglior predittore dello scarso funzionamento sociale nella schizofrenia. Lo scopo del presente lavoro è stato di esaminare la competenza di un gruppo di pazienti ambulatoriali affetti da schizofrenia in compiti di ToM, di riconoscimento di aspetti metaforici e idiomatici del linguaggio, in una prova di rispetto di regole conversazionali e di indagarne la relazione con il funzionamento sociale. **Metodi.** Sono stati reclutati 30 pazienti ambulatoriali con diagnosi di schizofrenia e 24 controlli sani. Sono stati somministrati il TIB per il calcolo del QI premorbo, la PANSS, il Theory of Mind Picture Sequencing Task, un test di comprensione di metafore e idiomi e un test conversazionale. Il funzionamento sociale è stato valutato con la PSP. **Risultati.** Non vi era differenza significativa tra i valori medi del QI premorbo del gruppo dei pazienti e dei controlli. Ai test di ToM e di competenza pragmatica, la differenza tra i gruppi è risultata altamente significativa, con i pazienti che hanno eseguito le prove in modo peggiore. È emersa una correlazione tra la comprensione di metafore e idiomi e le false credenze di secondo ordine. La PSP è risultata correlata con la PANSS e con la quota di ToM cognitiva, ma non con la ToM affettiva. **Conclusioni.** I risultati hanno mostrato che i soggetti affetti da schizofrenia, in condizione clinica di stabilizzazione, hanno evidenti difficoltà nelle prove di ToM e di comprensione del linguaggio figurato. Nel nostro modello teorico, la correlazione evidenziata tra la ToM cognitiva, i deficit pragmatici, lo stato clinico e il livello di funzionamento sociale suggerisce l'utilità di interventi riabilitativi di recupero delle funzioni metacognitive e delle abilità pragmatiche, al fine di ridurre la disabilità sociale nella schizofrenia.

PAROLE CHIAVE: teoria della mente, schizofrenia, metafore, idiomi, regole conversazionali, sintomi e funzionamento sociale.

INTRODUCTION

The phrase "Theory of Mind" (ToM) was coined by Premack and Woodruff¹ in the article "Does the chimpanzee have a Theory of Mind?", where chimpanzee's skill to pre-

dict behaviour of a human actor was investigated. These researchers employed ToM phrase to mean understanding ability of others mental state on the basis of behaviour observation.

Some years later on, it has been argued that ToM about

Theory of Mind and social functioning in schizophrenia

oneself as well as about others arose during hominids' evolution as an adaptive reaction to an even more demanding social environment². According to so-called "social brain hypothesis"^{2,3}, entities with suitable mind-reading skills could be more capable of social relationships than others, therefore achieving a greater reproductive success.

From an evolutionary point of view, it's a kind of interesting observation that the neural backbone system of ToM grew out of biological motion monitoring ability, as represented in superior temporal sulcus and in medial prefrontal cortex with special regard to the anterior cingulate cortex, otherwise from the neuronal systems contributing to imitative behaviour, as so-called "mirror neurons". In other words, monitoring of other entities behavioural motion among the same species could have established basis of other minds monitoring evolution⁴.

ToM involves different mentalising processes, as the ability to represent and understand mental states, both cognitive and affective, to reflect upon them, to attribute them to oneself or to others and to make inferences, allowing a proper behaviour comprehension and prediction. Over the past few decades, studies displayed ToM as a system, including cognitive and affective features, rather than an unitary process. Brothers and Ring⁵ suggested existence of "cold" and "warm" ToM sides, "cold", or cognitive, referring to inferences upon knowledge and beliefs, while "warm", or affective one, referring to inferences upon emotions⁶.

All over the literature, ToM notion has been often associated with empathy, nonetheless, since these two mental complex activities are deeply embedded, identifying a sharp boundary line both on the behavioural and on the neurobiological side seems to be a challenge.

However, although affective ToM and empathy are often employed as synonyms, a distinction must be made: while affective ToM deals with others mental states identification process, empathy goes beyond mental states inference getting the subject actively involved in sharing emotive experience with other people⁷.

Patients affected with schizophrenia show deficits in performing experimental tasks of ToM similarly to people affected with autism. However with some differences, since in autistic children impairment occurs at the beginning of development, while in schizophrenia it springs up at the disease onset⁸.

Although it is still under debate whether ToM deficit represents a state or trait feature, many studies displayed ToM impairments show up in the disease prodromic phase as well as during remission. Furthermore, other studies highlighted ToM deficit also in healthy relatives of patients affected with schizophrenia^{9,10}.

ToM deficit seems to be more relevant in patients with preponderance of negative as well as thought and speech disorganisation symptoms^{11,12}. ToM ability appears to be partially independent from neurocognitive functioning and general intelligence^{13,14}; moreover, no clear correlation with kind of psychopharmacologic treatment has been reported¹⁵. Within domains defining social cognition, ToM stands for the best predictor of poor social functioning in schizophrenia¹⁴⁻¹⁷.

Premorbid functioning, cognitive functioning, negative symptoms and depressive symptoms are the best predictors of functioning impairment in schizophrenia, though longitu-

dinal studies showed social functioning course to be quite independent from clinical symptomatology¹⁸. Indeed, functional remission does not correspond to neither runs out with symptoms resolution¹⁹.

Social cognition deficit could stand for a mediation factor within the well-documented relationship between clinical symptomatology, neurocognitive deficits and social functioning, an association that appears to be of a moderate degree so far²⁰⁻²⁴.

In patients with schizophrenia, even language is impaired both on the structure and on the content level, showing a greater deficit on the communicative or pragmatic level, with a direct consequence on global social functioning²⁵.

Eventually, many studies highlighted that patients with schizophrenia get in trouble with understanding figurative metaphorical and ironic thought, a ToM-related ability^{26,27}. This correlation remains even when results are controlled for IQ and executive functions influence²⁸. Mitchley et al.²⁹ sustained that irony comprehension does not correlate with general intelligence quality, as well a linear regression by Mo et al.³⁰ proved that total and verbal IQ don't account for metaphors and irony comprehension variance.

It's still an open issue whether a first order³¹⁻³³ or at least one order higher³⁴ ToM skill is sufficient for metaphors comprehension.

Similarly to findings in the autistic spectrum diseases, a poor comprehension of pragmatic rules implied in natural conversations between humans showed up in schizophrenic subjects too^{35,36}.

Within this investigation, we evaluated competence in ToM tasks, in metaphorical and idiomatic language identification tasks and in a conversational rules observance test in a group of outpatients affected with schizophrenia. Achieved performances were compared with those of healthy control subjects.

The current study aimed to explore relationship between ToM and social functioning in a group of outpatients suffering from schizophrenia, taking into account contribution of some variables as figurative language abnormalities, clinical symptomatology and general intelligence. According to guiding hypothesis, we assumed that a greater ToM and psychopathological impairment match with a lower social functioning level and a poorer inclusion to the belonging community.

If the hypothesis was valid, relevance of promoting rehabilitation programs with respect to both metacognitive and communicative-pragmatic abilities, in order to decrease social disability in schizophrenia, would clearly come out.

METHODS

Participants

For current study, 30 outpatients diagnosed with schizophrenia (19 males, 11 females) and 24 healthy subjects (12 males, 12 females) had been recruited. Patients affected with schizophrenia attended Mental Health Centre within 3rd Psychiatric Service in Padua. Schizophrenia diagnosis was made according to DSM-IV-TR criteria³⁷. Patients with any subtype of schizophrenia diagnosis were included, providing they were under a stable clinical condition without any acute event in the previous three months.

Within schizophrenia subtypes, paranoid was the most represented with 24 patients, then came undifferentiated (3 patients), residual (2 patients) and disorganized (1 patient). Ages spread from 18 to 65 years old. Patients with substances abuse, brain injuries, severe sensory deficits as hearing or visual impairment and severely threaten general medical condition were excluded.

All patients were on antipsychotic treatment with typical or atypical drugs, in oral or long acting formulation, which can be considered moderate, with a mean equivalent daily chlorpromazine dose of 415.49 ± 291.44 mg³⁸.

Control group subjects were recruited from general population: no history of mental disorder, head injuries or alcohol and substances abuse was allowed. All participants provided written informed consent.

All subjects were native Italian speakers. Concerning sociodemographic data, no significant differences were found between patients and controls with regard to gender ($\chi^2(1)=0.969$; $p=0.325$), age ($U=350.500$; $p=0.868$) and education level, evaluated in years of study ($U=275.500$; $p=0.113$) (Table 1). Males ($n=19$) with a mean age of 47.26 ± 8.63 years account for 63.3% of the sample, while female patients ($n=11$) with a mean age of 42.18 ± 7.22 years account for 36.7%. Globally considered, patient sample consists of subjects with a mean age of 45.40 ± 8.39 years, 9.60 ± 2.73 mean education years, 16.03 ± 8.69 mean years of disease duration and a mean age of onset of 29.36 ± 8.98 years. Unmarried patients account for 83.3%, divorced or separated for 10%, married for 6.7%.

About 76.7% of patients lived autonomously in the community, while about 23.3% lived in social valiant apartment groups; 70% of all patients didn't work at all.

Intellective Quotient

Premorbid intellective quotient value (IQ) was calculate using Brief Intelligence Test (TIB)^{39,40}, an Italian adaptation from National Adult Reading Test⁴¹. It consists of a checklist of 54 words with irregular word stress: 34 real test-words and 20 control-words with high use frequency in language. Patient is asked to read the words aloud without any pause. Examiner notes down any pronunciation or word stress mistake. TIB score is provided by sum of all real-test words mistakes.

Age, sex and education are taken into account in regression equations, leading to computation of performance IQ, verbal IQ and total IQ. To this study purpose, total IQ was considered.

Clinical assessment

Patients clinical psychopathologic status with special regards to the week before the interview was assessed with Positive and Negative Syndrome Scale (PANSS) by Kay et al.⁴²; it consists of 30 items split in 3 subscales. The PANSS-P subscale consists of 7 items and deals with positive symptoms; PANSS-N consists of 7 items and deals with negative symptoms; finally, PANSS-G deals with general psychopathology and includes 16 items.

Metaphors and idiomatic expressions comprehension test

Specific features kind of interest matter to this work were investigated using "Metaphors and idioms comprehension test"⁴³. It consists of a checklist of 20 metaphorical plus 20 idiomatic ex-

pressions currently used in Italian language. Keeping a vague encouraging attitude, the examiner reads the expressions aloud asking the patient to illustrate the meaning in his own words, for example: "What does it mean: that man drowns in a water glass?". For each item, 2 scores can be appointed: a value of 2 if patient's definition is compliant with the one provided by comparison of widespread Italian dictionaries; a value of 1 when metaphorical meaning is partially identified or a correct but concrete exemplification occurs. For unsuitable or not given answers a value of 0 is provided. Correction grid are available with regards to some age and/or education level combinations.

Pragmatic competence test

To assess pragmatic competence we employed an adaptation from Conversational Violation Test⁴⁴⁻⁴⁶. It consists of 25 short conversational exchanges, in the form of dialogues between 3 characters. In every dialogue, the main character asks a question to the other two and each of them gives a short answer: among the two, one answer violates a Gricean conversational maxim. Five sheets are provided to the patients, one by one. Each sheet conveys 5 dialogues, patient is asked to read one dialogue at time, find the proper answer and put a check mark on it. Conversational exchanges are very short in order to avoid failure due to mnemonic demands or to other processing factors. Overall, first and second maxims of quantity ("do not be reticent" and "do not give superfluous information"), first maxim of quality ("do not tell something you believe to be untrue"), maxim of relation ("be relevant") and courtesy maxim ("be polite") are violated. Final score comes from total mistakes number and goes from a theoretical value of 0 (no mistakes at all) to 25 (all answers are wrong).

Theory of mind evaluation test

Theory of Mind Picture Sequencing Task by Brüne¹³ assesses individual abilities of understanding others mental states both on verbal and non verbal side.

In this test, several intentionality levels are used in a "on line" unique setting, close to real life practise as much as possible, cause to be easier catching various characters perspective in the stories.

It has been specifically created to evaluate ToM in patients affected with schizophrenia, therefore featuring easy and brief test administration. It consists of 6 stories, each made of 4 cartoons. Cartoons are provided covered in a random order. Patient is asked to uncover them and arrange a sequence of events along with logic as fast as possible. For each story, 2 points are assigned if first and fourth cartoons were put in the right place along the sequence and 1 point if second and third one were correct, achieving a "images reordering score" or ToM-I from 0 to 36. Furthermore, subject answers some questions aiming to assess comprehension of characters mental states in stories, achieving a "survey score" or ToM-Q from 0 to 23.

Social functioning assessment

Participants social functioning was assessed with Personal and Social Performance (PSP)⁴⁷. PSP is an updated version of Social and Occupational Functioning Assessment Scale (SOFAS)⁴⁸. It consists of a sequence of values (1 to 100) divided into 10 equal ranges, the upper two identifying high functioning subjects. Four functioning areas are evaluated: socially useful activities, including

Theory of Mind and social functioning in schizophrenia

work and study; social and personal relationships; self-care; disturbing and aggressive behaviours. For each area, examiner assigns a proper value with respect to patient impairment: 1-absent, 2-low, 3-evident, 4-pronounced, 5-severe, 6-extremely severe. On the score basis, proper range of patient functioning is identified.

Statistical Analyses

Statistical analyses were carried out using SPSS Statistics 17.0 for Windows. Sociodemographic data comparison between patients and controls were performed with χ^2 -test for gender, while non-parametric Mann-Whitney U test was employed for age and educational level.

Preparatory descriptive analyses were carried out with Shapiro-Wilk test to check for data normal distribution. Considering non-normal distribution of some results, especially in the control group, comparison analyses between groups were outlined by non-parametric Mann-Whitney U test.

For the same reason, correlation analyses were made calculating Spearman rho coefficient.

Whether feasible, Pearson r correlations were calculated in the patients group.

With respect to some variables, a standard multiple linear regression equation "by blocks" was carried out using SPSS.

Patients performed worse than controls and comparison using non-parametric U di Mann-Whitney showed a highly significant difference both for metaphors ($U=117.00$; $p<0.000$) and for idioms ($U=105.00$; $p<0.000$).

In the pragmatic competence test, mean number of wrong answers was 5.20 ± 3.27 in the patients group, within a range of values spreading from 0 to 12.

Control group instead achieved a mean value of 1.75 ± 2.34 (from 0 to 10). Groups comparison displayed a very significant difference ($U=138.00$; $p<0.000$) (Table 1).

Theory of mind test

Patients achieved a ToM-I or "images reordering" score of 20.46 ± 7.93 , while on the cognitive side they attained a ToM-Q or "survey" score of 16.56 ± 4.0 . First order false beliefs score was 1.53 ± 0.62 whereas second order was 1.63 ± 0.85 .

Controls scores were 32.12 ± 4.55 for ToM-I and 22.04 ± 2.17 for ToM-Q; in first order false beliefs 1.91 ± 0.28 and 2.97 ± 0.50 for second order.

Group comparison disclosed that patients provided a lower performance than controls in all ToM-I ($U=90.500$; $p<0.000$) and ToM-Q items ($U=64.500$; $p<0.000$), in first ($U=244.000$; $p=0.008$) and in second order ($U=95.500$; $p<0.000$) false beliefs.

RESULTS

Premorbid IQ, clinical assessment and social functioning

Patients got a mean premorbid IQ score of 106.79 ± 6.65 , within a range extending from 91.07 to 117.17, positively comparable to general population.

Control group mean IQ score was 109.66 ± 6.14 . No significant disparity was detected between the two groups ($U=251.00$; $p=0.058$).

Patients group clinical condition was judged to be moderately severe, due to mean PANSS score of 82.40 ± 15.51 , outspreading values from a minimum of 50 to a maximum of 122. PANSS-Positive, PANSS-negative and PANSS-general mean score was 16.46 ± 6.61 , 25.93 ± 5.95 and 41.03 ± 13.34 , respectively.

Patients group mean score at PSP scale was of 43.66 ± 13.44 , covering a range of values from a minimum of 23.0 to a maximum of 85.0. That stands for a remarkably impaired social functioning. This finding matched qualitative observation upon our sample: patients in their forties, living in birth families or alone, without any employment (Table 1).

Metaphors and idioms comprehension and pragmatic competence tests

Patients group attained a mean score of 23.83 ± 7.75 in the metaphors comprehension test (minimum of 12 to a maximum of 37), while in the idioms comprehension test the mean score was 22.63 ± 7.58 (minimum of 10 to a maximum of 39). In both cases, achievable scores was included within the range of 0-40.

Control group attained a mean score of 32.58 ± 4.94 in the metaphors and a score of 32.00 ± 5.13 in the idioms subscale.

Correlations in the control group

In order to investigate relation occurring between results from main test administered in the control group, a Spearman rho correlation matrix was carried out.

With regards to metaphors, a significant correlation came out with regards to second order false beliefs ($\rho=0.417$; $p=0.043$) and with IQ ($\rho=0.606$; $p=0.002$), while none with first order false beliefs.

Idioms correlated with IQ ($\rho=0.581$; $p=0.003$) and with CVT ($\rho=0.424$; $p=0.039$). Both ToM tests displayed a correlation with IQ, ToM-I ($\rho=0.663$; $p<0.000$) and ToM-Q ($\rho=0.509$, $p=0.011$).

It was kind of interesting that in the control group the pragmatic competence test correlated significantly with idioms identification ($\rho=0.424$, $p=0.039$) and IQ ($\rho=-0.498$, $p=0.013$). This could depend on knowledge of – so to speak – "conventional" features, usually required both in verbal exchanges and in those tests. Furthermore, premorbid IQ value drawn from TIB relies on awareness of pronunciation and word stress socially shared by the speakers community.

Correlations in the patients group

In the patients group, once again Spearman rho correlation matrix was employed, including mean CPZ dose, PSP, PANSS-P and PANSS-N scores. We removed N5 concretism item "difficulty in abstract thinking" to avoid any overlapping with metaphors and idioms comprehension test (Table 2).

Among most significant connections, metaphors and idioms comprehension test showed a strong correlation with ToM-I and ToM-Q and with social functioning scores. Noteworthy, metaphors and idioms test correlated with second or-

Table 1 Participants test results, clinical and sociodemographic characteristics

| | Patients | Controls | χ^2/ U^* | p-value |
|-------------------------------------|---------------|-------------|---------------|---------|
| N | 30 | 24 | | |
| Males(n)/Females(n) | 19/11 | 12/12 | 0.969 | 0.325 |
| Mean age (years) | 45.40±8.39 | 46.37±7.92 | 350.500 | 0.868 |
| Education (years) | 9.60±2.73 | 10.70±2.89 | 275.500 | 0.113 |
| Illness duration (years) | 16.03±8.69 | | | |
| Onset age (years) | 29.36±8.98 | | | |
| IQ | 106.79±6.65 | 109.66±6.14 | | 0.058 |
| Metaphors | 23.83±7.75 | 32.58±4.94 | | 0.000 |
| Idioms | 22.63±7.58 | 32.00±5.13 | | 0.000 |
| CVT | 5.20±3.27 | 1.75±2.34 | | 0.000 |
| ToM-I | 20.46±7.93 | 32.12±4.55 | | 0.000 |
| ToM-Q | 16.56±4.40 | 22.04±2.17 | | 0.000 |
| 1 st order false beliefs | 1.53±0.62 | 1.91±0.28 | | 0.008 |
| 2 nd order false beliefs | 1.63±0.85 | 2.97±0.50 | | 0.000 |
| PANSS | 82.40±15.51 | | | |
| PANSS-P | 16.46±6.61 | | | |
| PANSS-N | 25.93±5.95 | | | |
| PANSS-G | 41.03±13.34 | | | |
| PSP | 43.66±13.44 | | | |
| Mean CPZ dose | 415.49±291.44 | | | |

*Comparison of gender was carried out with χ^2 test, while nonparametric Mann-Whitney U test was employed for other variables.

der false beliefs ($\rho=0.369$, $p=0.045$; $\rho=0.472$, $p=0.008$), whereas they didn't display any connection with first order false beliefs, according to previous literature findings showing that both metaphors and irony comprehension correlate with higher than first order false beliefs.

Correlations between metaphors and social functioning ($\rho=0.403$, $p=0.027$), as like as between idioms and social functioning ($\rho=0.417$, $p=0.022$) turned out to be highly significant, suggesting the relevance of rehabilitative techniques developed taking into account figurative language within interventions focused on reducing disability in schizophrenia.

Quite amazingly but according to previous literature data on connection between neurocognitive test performance and psychopharmacologic treatment, our metaphors and idioms comprehension test and ToM test, especially second order false beliefs, showed a highly significant correlation with mean daily equivalent CPZ dose.

In our sample, metaphors and idioms comprehension test showed a correlation to IQ scores, too.

Another finding compliant with literature was correlation between metaphors comprehension and negative symptoms cluster, with a negative connection. Negative symptoms as-

sessed with PANSS without N5 "difficulty in abstract thinking" are: "blunted affect", "emotional withdrawal", "poor rapport", "passive/apathetic social withdrawal", "lack of spontaneity and flow of conversation" and "stereotyped thinking". When it came to our sample, the more severe these symptoms were, the lower metaphors comprehension ability showed up ($\rho=-0.367$, $p=0.046$).

Unlike control group, pragmatic competence test-CVT didn't show any connection.

ToM tests were correlated to disease duration, especially ToM-I ($\rho=-0.375$, $p=0.041$), ToM-Q ($\rho=-0.504$, $p=0.004$) and second order false beliefs ($\rho=-0.404$, $p=0.027$). In contrast to literature findings, no significant correlation arose between disease duration and social functioning in our sample ($\rho=-0.089$, $p=0.639$) (Table 2).

Social functioning, clinical symptomatology and Theory of Mind

Analysis of relationship between social functioning level, clinical symptomatology and ToM was carried out through a Spearman ρ correlation matrix, splitting PSP into its 4

Theory of Mind and social functioning in schizophrenia

Table 2. Patients group: Spearman' rho correlation

| | Metaphors | Idioms | ToM-I | ToM-Q | False 1 st | False 2 nd | CVT | IQ | PP | P-N5 | PSP | Disease duration | CPZ |
|-----------------------|-----------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------|-----------------------|---------------|-----------------------|------------------------|------------------------|------------------------|
| Metaphors | 1 | .881* .000 | .452* .012 | .448* .013 | .044 .818 | .369* .045 | -.022 .909 | .386* .035 | .166 .381 | -.367* .046 | .403* .027 | -.312 .093 | -.397* .030 |
| Idioms | | 1 | .474** .008 | .558** .001 | .091 .634 | .472** .008 | -.035 .852 | .422* .020 | .210 .265 | -.284 .128 | .417* .022 | -.335 .071 | -.494** .005 |
| ToM-I | | | 1 | .658* .000 | .396* .030 | .578** .001 | -.311 .094 | .553** .002 | -.202 .284 | -.069 .718 | .334 .071 | -.375* .041 | -.462* .010 |
| ToM-Q | | | | 1 | .666** .000 | .779** .000 | -.139 .464 | .192 .309 | -.135 .478 | -.103 .588 | .485** .007 | -.504** .004 | -.440* .015 |
| False 1 st | | | | | 1 | .433* .017 | .069 .718 | -.039 .839 | -.036 .849 | -.172 .365 | .146 .441 | -.239 .204 | -.272 .146 |
| False 2 nd | | | | | | 1 | -.282 .131 | .327 .078 | .052 .783 | -.118 .536 | .307 .099 | -.404* .027 | -.525** .003 |
| CVT | | | | | | | 1 | -.199 .292 | .174 .358 | .082 .665 | -.219 .245 | .168 .375 | .291 .119 |
| IQ | | | | | | | | 1 | .084 .657 | .287 .124 | -.078 .681 | -.121 .523 | -.353 .056 |
| PP | | | | | | | | | 1 | -.176 .352 | -.498** .005 | .045 .814 | .032 .868 |
| P-N5 | | | | | | | | | | 1 | -.332 .073 | .187 .324 | .185 .327 |
| PSP | | | | | | | | | | | 1 | -.089 .639 | -.284 .129 |
| Disease duration | | | | | | | | | | | | 1 | .209 .267 |
| CPZ | | | | | | | | | | | | | 1 |

* Significant correlation to 0.05 level (2-code)
** Significant correlation to 0.01 level (2-code)

items and searching for correlations with PANSS, ToM-I and ToM-Q scores (Table 3).

Among the most significant correlations, PANSS correlated with total PSP (rho=-0.763, p<0.000) and to all four scale items considered one by one. ToM-I score didn't correlate with PSP neither with PANSS. ToM-Q score instead showed an highly correlation with total PSP (rho=0.485, p=0.007) and with "social useful activities" (rho=0.485, p=0.007) and "relationships" (rho=-0.404, p=0.027) items.

As regards to clinical symptomatology effect on social functioning, we found that only negative and general symptoms correlated with the "social relevant activities" item, while only general symptoms correlated with "personal and social relationships" item; "self-care" correlated with all the three symptomatology fields, positive negative and general; aggressiveness correlated with positive and general symptoms, apart from negative ones.

Our data on positive symptoms being correlated to specific subdomains of social functioning and at any rate showing a lower connection strength than negative and general symptoms comply with recent literature on the topic¹⁶.

After testing for normality of data distribution, it was feasible to carry out a Pearson r correlation matrix between PSP, PANSS and ToM-I and ToM-Q scores. It came out that PSP exhibited a significant linear correlation with PANSS

(r=-0.758, p<0.000) and with ToM-Q (r=0.473, p<0.008), while no connection was found with ToM-I (r=0.344; p=0.063).

In order to analyse the ToM-Q and clinical status predictive value on social functioning, a standard multiple linear regression "by blocks" was carried out, entering PSP as dependent variable and ToM-Q and PANSS scores as independent variables. Global model came across as significant (F=26.926 p<.000), predicting 64% of PSP variance (corrected R²=0.641). In the equation, predictive power of PANSS (=0.684, t=-5.978, p=0.000) appeared to be higher than ToM-Q (=0.312, t=2.725, p=0.011) (Table 4).

DISCUSSION

In the current study, relationship between ToM and social functioning was investigated in a sample of Italian outpatients diagnosed with schizophrenia on a stable clinical condition, taking into account influence of some variables, as like as figurative language abnormalities, clinical symptomatology and general intelligence.

Patients group showed a lower performance than controls approximately in all tasks, according to previous data on poor competence in ToM tasks in schizophrenia⁴⁹⁻⁵². It has

Table 3. Patient group: Spearman rho correlation, social functioning, clinical symptomatology, ToM scores

| | PSP | Socially useful activities | Relationships | Self-care | Disturbing and aggressive behaviour | PANSS | PANSS-P | PANSS-N | PANSS-G | ToM-I | ToM-Q |
|-------------------------------------|-----|----------------------------|------------------------|------------------------|-------------------------------------|------------------------|------------------------|------------------------|------------------------|---------------|-----------------------|
| PSP | 1 | -.826* .000 | -.687** .000 | -.580** .001 | -.730** .000 | -.763** .000 | -.498** .005 | -.527** .003 | -.661** .000 | .334 .071 | .485** .007 |
| Socially useful activities | | 1 | .605** .000 | .538** .002 | .650** .000 | .630** .000 | .315 .089 | .519** .003 | .530** .003 | -.265 .156 | -.404* .027 |
| Relationships | | | 1 | .204 .279 | .407* .022 | .583** .001 | .264 .158 | .328 .077 | .544** .002 | -.144 .449 | -.404* .027 |
| Self-care | | | | 1 | .635* .000 | .582** .001 | .367* .046 | .600** .000 | .526** .003 | -.310 .095 | -.165 .382 |
| Disturbing and aggressive behaviour | | | | | 1 | .694** .000 | .566** .001 | .348 .060 | .625** .000 | -.247 .189 | -.209 .568 |
| PANSS | | | | | | 1 | .607** .000 | .499** .005 | .965** .000 | -.192 .309 | -.280 .134 |
| PANSS-P | | | | | | | 1 | .032 .868 | .643** .000 | -.202 .284 | -.135 .478 |
| PANSS-N | | | | | | | | 1 | .409* .114 | -.294 .114 | -.334 .072 |
| PANSS-G | | | | | | | | | 1 | -.161 .394 | -.224 .234 |
| ToM-I | | | | | | | | | | 1 | .658** .000 |
| ToM-Q | | | | | | | | | | | 1 |

* Significant correlation to 0,05 level (2-code)
** Significant correlation to 0,01 level (2-code)

Table 4. Multiple linear regression analysis

| Model | Non standardized coefficients | | Standardized coefficients | t | Sig. |
|------------|-------------------------------|--------------------------|---------------------------|--------|------|
| | B | Standard Deviation error | Beta | | |
| (Constant) | 66.762 | 9.780 | | 6.827 | .000 |
| PANSS | -.472 | .079 | -.684 | -5.978 | .000 |
| ToM-Q | .951 | .349 | .312 | 2.725 | .011 |

Dependent variable: PSP

been under discussion whether this deficit is a trait or state feature, leading to contrasting results over a long time. On the basis of observations on deficit persistence beyond disease acute phase, recent studies support the trait thesis⁵³⁻⁵⁵.

Our results confirmed that schizophrenic subjects show an impairment in figurative language comprehension^{30,56,57} and communicative pragmatic aspects^{36,58} compared to controls.

Concerning social functioning, a statistically significant correlation with ToM turned up: it concurred to better community functioning in patients with a greater ToM competence, as yet reported in literature^{14,59,60}. In our sample specifically, relation between cognitive and affective ToM showed up to be significant. Since cognitive ToM relies on a more complex and sophisticated mentalising skill than affective ToM, its tighter correlation with social functioning appears to be reasonable and gets along well with recent studies^{16,61,62}. Otherwise, test choice may be of some influence on reported isolated cognitive ToM involvement.

On the analysis of relationship among social functioning, clinical symptomatology and ToM, a noteworthy finding was a significant correlation between PANSS-measured clinical symptoms and all PSP items. Moreover, a significant correlation arose between cognitive ToM and PSP “socially useful activities” and “personal and social relationships” items, as a further attestation about intact ToM relevance for a satisfying community integration.

Another interesting finding was correlation between metaphorical and idiomatic expressions comprehension and ToM, both in the cognitive and in the affective subcomponent.

According to literature^{26,27,30}, even relation with second order false beliefs showed up to be significant, on the same

Theory of Mind and social functioning in schizophrenia

line of recent studies arguing that figurative language understanding is tightly related to higher than first order false beliefs comprehension, both belonging to a more sophisticated ToM level.

Metaphorical but not idiomatic expressions happened to be correlated to negative symptoms, too. In spite of few data thereupon, a recent study³⁴ displayed a correlation between metaphors comprehension and PANSS-measured negative symptoms, with exclusion of N5 criterion “difficulty of abstract thinking”. As metaphors are an integral part of common language, mistaken interpretation can make the subject restrict social relationships, leading to a progressive worsening of negative symptomatology.

Previously, Mitchley et al.²⁹ proved that schizophrenic subjects showed an impairment in irony comprehension, having rather a literal reading of ironic stories. Irony comprehension failure in patients with schizophrenia was associated with negative symptoms and lower IQ. In the current study, a correlation between figurative language understanding and social functioning arose. This finding could give a hint on how impaired comprehension of metaphors and idioms usually employed in natural conversations can promote social withdrawal. Thus, developing rehabilitative trainings focused on communicative-pragmatic abilities recovery appears to be relevant in schizophrenic patients.

As foretold, patients displayed many execution deficits in the conversational rules observance test, scoring a greater mistakes number than controls. This finding appears compliant with literature on pragmatic deficits in schizophrenia⁵⁸. No significant correlations showed up between CVT and other tests scores. Specific correlations could arise calculating mistakes per single maxim type rather than in a total counting; previous research found a correlation between “relationship maxim” violation and total ToM score⁶³.

In our work, a significant correlation between metaphors comprehension test and premorbid IQ turned up. Over literature, general intelligence role in figurative language comprehension is still under analysis. According to Brüne and Bodenstein²⁸, IQ, ToM and executive functions are tightly related to proverb comprehension in schizophrenic patients. In a linear regression model, entering as dependent variable proverb comprehension and as independent variables IQ, executive functions and ToM respectively, the equation resulted as significant ensuring a prediction of 39% of variance. Noteworthy, significance remained even when IQ and executive functions influence was removed. Mo et al.³⁰ proved that metaphors and irony comprehension are independent from general intelligence and verbal IQ.

With regards to general intelligence, a significant correlation with affective but not with cognitive ToM subcomponent arose. As described in literature, IQ participates in ToM performance, though not entirely accounting for its impairment in the schizophrenic population^{13,14}.

Another subject matter for discussion in this study was mean equivalent CPZ dose influence on ToM as well as on metaphors and idioms comprehension tests. Concerning our sample, a negative correlation arose between mean equivalent CPZ dose, ToM and figurative language comprehension performances. Identifying precisely antipsychotic treatment effects on test performances still remains a challenging task. As known, cognitive dysfunction stands for a key symptom in schizophrenia, due to arrangement of two factors: cogni-

tive deficit caused from both disease itself and psychopharmacological therapy. Finding a sharp boundary it's a kind of difficult task, in absence of significant evidences on drugs improving cognitive deficit resulted from schizophrenia disease⁶⁴.

With regards of our data and previous literature findings, in order to investigate predictive value of ToM-Q test and clinical condition on social functioning, a standard linear regression analysis was carried out, entering PSP as dependent variable and ToM-Q and PANSS scores as independent variables. We achieved a significant regression model with a 0.641 corrected R². Although PSP shows up as a less analytic tool than Life Skills Profile⁶⁵ or Honos⁶⁶ in the assessment of schizophrenic outpatients living in the community, nonetheless our data are consistent with scientific literature. Social cognition domains can mediate the relationship between neurocognitive functions and functional outcome, accounting for a greater variance quota as compared with standard neurocognitive measures^{67,68}.

Our study limits can be considered sample size and lack of a neurocognitive evaluation. A greater sample size gives increased power to statistical evidences. This goal is usually achieved in multicentre studies, while ours was fully carried out in one Mental Health Centre.

Lack of patients' neurocognitive assessment prevented further investigations on cognitive decline influence on ToM test performances, which happens to be relevant to some extent. Nonetheless, it's noteworthy that ToM independence from neurocognitive functions is still under debate. Most recent studies²⁴ argue that general cognitive abilities are required although not sufficient for a proper mentalisation skill.

Mehta et al.⁶⁹ investigated several neurocognitive domains in order to find out which ones were best cognitive predictors of social cognition dimensions, using a multiple regression model in a group of schizophrenic patients on remission. Attention and executive functions appeared to predict ToM first order false beliefs, while the best predictor for second order ones was memory. Social cognition abilities were thus determined by single aspects, with overall neurocognition predicting from 4% to 40% of social cognition variance.

CONCLUSIONS

From our work evidences arose on the need to associate psychopharmacologic treatment and rehabilitative trainings aimed at treating cognitive dysfunctions as well as supporting metacognitive functions. In the current scenario, some psychological interventions are available, such as the Metacognitive Training (MCT) for psychosis. Both a group and individual training, it embeds ToM domain, by facial expression recognition and interpretation of cartoons depicting human interactions, into psicoeducational, cognitive behavioural and cognitive remediation therapy elements⁷⁰. A further group therapy program is the Integrated Psychological Therapy (IPT), a combination of neurocognitive and social cognitive interventions with social skills and problem-solving tasks; it showed up as an effective rehabilitation approach for schizophrenia⁷¹. Since recovery criteria go beyond symptom remission laying special emphasis on personal and social

functioning in residence, work, and spare time, those rehabilitation interventions can contribute to decrease social disability related to the disease.

Eventually, future research developments from the current study can address diagnosis and treatment of first episode psychosis, in adolescence and young adulthood, as well as other psychopathological domains, such as borderline, depression and eating disorders.

Conflict of interests: the authors declare they have no competing interests.

REFERENCES

1. Premack D, Woodruff G. Does the chimpanzee have a theory of mind? *Behav Brain Sci* 1978; 1: 515-26.
2. Brothers L. The social brain: a project for integrating primate behaviour and neuropsychology in a new domain. *Concepts Neurosci* 1990; 1: 25-51.
3. Dunbar RIM. The social brain hypothesis. *Evol Antrophol* 1998; 6: 178-90.
4. Rizzolatti G, Fadiga L, Gallese V, Fogassi L. Premotor cortex and the recognition of motor actions. *Brain Res Cogn Brain Res* 1996; 3: 131-41.
5. Brothers L, Ring B. A neuroethological framework for the representation of minds. *J Cogn Neurosci* 1992; 4: 107-18.
6. Shamay-Tsoory SG, Shur S, Barcai-Goodman L, Medlovich S, Harari H, Levkovitz Y. Dissociation of cognitive from affective components of theory of mind in schizophrenia. *Psychiatry Res* 2007; 149: 11-23.
7. Gallese V, Keysers C, Rizzolatti G. A unifying view of the basis of social cognition. *Trends Cogn Sci* 2004; 8: 396-403.
8. Frith CD. *The cognitive neuropsychology of schizophrenia*. Hove, UK: Lawrence Erlbaum Associates, 1992.
9. Anselmetti S, Bechi M, Bosia M, et al. "Theory" of mind impairment in patients affected by schizophrenia and in their parents. *Schizophr Res* 2009; 115: 278-85.
10. Pentaraki AD, Stefanis NC, Stahl D, et al. Theory of Mind as a potential trait marker of schizophrenia: a family study. *Cog Neuropsychiatry* 2012; 17: 64-89.
11. Ventura J, Hellemann GS, Thames AD, Koellner V, Nuechterlein KH. Symptoms as mediators of the relationship between neurocognition and functional outcome in schizophrenia: a meta-analysis. *Schizophr Res* 2009; 113: 189-99.
12. Robertson BR, Prestia D, Twamley EW, Patterson TL, Bowie CR, Harvey PD. Social competence versus negative symptoms as predictors of real world social functioning in schizophrenia. *Schizophr Res* 2014; 160: 136-41.
13. Brüne M. Theory of Mind and role of IQ in chronic disorganized schizophrenia. *Schizophr Res* 2003; 60: 57-64.
14. Brüne M, Schaub D, Juckel G, Langdon R. Social skills and behavioural problems in schizophrenia: The role of mental state attribution, neurocognition and clinical symptomatology. *Psychiatry Res* 2011; 190: 9-17.
15. Brüne M, Abdel-Hamid M, Lehmkamper C, Sonntag C. Mental state attribution, neurocognitive functioning, and psychopathology: what predicts poor social competence in a schizophrenia best? *Schizophr Res* 2007; 92: 151-59.
16. Brown EC, Tas C, Can H, Esen-Danaci A, Brüne M. A closer look at the relationship between the subdomains of social functioning, social cognition and symptomatology in clinically stable patients with schizophrenia. *Compr Psychiatry* 2014; 55: 25-32.
17. Martínez-Domínguez S, Penadés R, Segura B, González-Rodríguez A, Catalán R. Influence of social cognition on daily functioning in schizophrenia: study of incremental validity and mediational effects. *Psychiatry Res* 2015; 374-80.
18. Peuskens J, Gorwood P, EGOFORs Initiative. How are we assessing functioning in schizophrenia? A need for a consensus approach. *Eur Psychiatry* 2012; 27: 391-5.
19. Addington J, Cornblatt BA, Cadenhead KS, et al. At clinical high risk for psychosis: outcome for nonconverters. *Am J Psychiatry* 2011; 168: 800-5.
20. Green MF, Nuechterlein KH. Should schizophrenia be treated as neurocognitive disorder? *Schizophr Bull* 1999; 25: 309-19.
21. Green MF, Kern RS, Braff DL, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the "right stuff"? *Schizophr Bull* 2000; 26: 119-36.
22. Green MF, Nuechterlein KH. The MATRICS initiative: developing a consensus cognitive battery for clinical trials. *Schizophr Res* 2004; 72: 1-3.
23. Brekke JS, Kay DD, Kee KS, Green MF. Biosocial pathways to functional outcome in schizophrenia. *Schizophr Res* 2005; 80: 213-25.
24. Penn DL, Sanna LJ, Roberts DL. Social cognition in schizophrenia: an overview. *Schizophr Bull* 2008; 34: 408-11.
25. Bowie CR, Harvey PD. Communication abnormalities predict functional outcomes in chronic schizophrenia: differential associations with social and adaptive functions. *Schizophr Res* 2008; 103: 240-7.
26. Gavilán Ibáñez JM, García-Albea Ristol JE. Theory of mind and language comprehension in schizophrenia: poor mindreading affects figurative language comprehension beyond intelligence deficits. *J Neuroling* 2011; 24: 54-69.
27. Gavilán Ibáñez JM, García-Albea Ristol JE. Theory of mind and language comprehension in schizophrenia. *Psicothema* 2013; 25: 440-5.
28. Brüne M, Bodenstein L. Proverb comprehension reconsidered – "theory of mind" and the pragmatic use of language in schizophrenia. *Schizophr Res* 2005; 75: 233-9.
29. Mitchley NJ, Barber J, Gray JM, Brooks N, Livingston MG. Comprehension of irony in schizophrenia. *Cogn Neuropsychiatry* 1998; 3: 127-38.
30. Mo S, Su Y, Chan RCK, Liu J. Comprehension of metaphor and irony in schizophrenia during remission: the role of theory of mind and IQ. *Psychiatry Res* 2008; 157: 21-9.
31. Happè H. An advanced test of theory of mind: understanding of story characters' thought, feelings by able autistic, mentally handicapped, and normal children and adults. *J Autism Dev Disord* 1994; 24: 129-54.
32. Langdon R, Coltheart M, Ward PB, Catts SV. Disturbed communication in schizophrenia: the role of poor pragmatics and poor mind-reading. *Psychol Med* 2002; 32: 1273-84.
33. Langdon R, Davies M, Coltheart M. Understanding minds and understanding communicated meanings in schizophrenia. *Mind Lang* 2002; 17: 68-104.
34. Mossaheb N, Aschauer HN, Stoettner S, et al. Comprehension of metaphors in patients with schizophrenia-spectrum disorders. *Compr Psychiatry* 2014; 55: 928-37.
35. Tényi T, Herold R, Szili IM, Trixler M. Schizophrenics show a failure in the decoding of violations of conversational implicatures. *Psychopathology* 2002; 35: 25-7.
36. Mazza M, Di Michele V, Pollice R, Casacchia M, Roncone R. Pragmatic language and theory of mind deficits in people with schizophrenia and their relatives. *Psychopathology* 2008; 41: 254-63.
37. American Psychiatric Association. *DSM-IV-TR Diagnostic and statistical manual of mental disorders, 4th Edition Text Revision*. Washington, DC: American Psychiatric Association Publishing, 2000.
38. Andreasen NC, Pressler M, Nopoulos P, Miller D, Ho BC. Antipsychotic dose equivalents and dose-years: a standardized method for comparing exposure to different drugs. *Biol Psychiatry* 2010; 67: 255-62.
39. Sartori G, Colombo L, Vallar G, Rusconi ML, Pinarello A. TIB: Test di Intelligenza Breve per la valutazione del quoziente intellettivo attuale e pre-morboso. *La Professione di Psicologo* 1997; 1: 2-24.

Theory of Mind and social functioning in schizophrenia

40. Stratta P, Riccardi I, Tomassini A, Marronaro M, Pacifico R, Rossi A. Premorbid intelligence of inpatients with different psychiatric diagnoses does not differ. *Neuropsychiatr Dis Treat* 2008; 4: 1241-4.
41. Nelson HE. The National Adult Reading Test (NART): test manual. Windsor, UK: NFER-Nelson, 1982.
42. Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophr Bull* 1987; 13: 261-76.
43. Papagno C, Cappa SF, Garavaglia G, et al. La comprensione non letterale del linguaggio: taratura di un test di comprensione di metafore e di espressioni idiomatiche. *Archivio di Psicologia, Neurologia e Psichiatria* 1995; 56: 402-20.
44. Surian L, Baron-Cohen S, Van der Lely H. Are children with autism deaf to gricean maxims? *Cognit Neuropsychiatry* 1996; 1: 55-71.
45. Surian L, Siegal M. Sources of Performance on Theory of Mind Tasks in Right Hemisphere-Damaged Patients. *Brain and Language* 2001; 78: 224-32.
46. Di Michele V, Mazza M, Cerbo R, Roncone R, Casacchia M. Deficits in pragmatic conversation as manifestation of genetic liability in autism. *Clinical Neuropsychiatry* 2007; 4: 144-51.
47. Morosini PL, Magliano L, Brambilla L, Ugolini S, Pioli R. Development, reliability and acceptability of a new version of the DSM-IV Social and Occupational Functioning Assessment Scale (SOFAS) to assess routine social functioning. *Acta Psychiatr Scand* 2000; 161: 323-9.
48. Goldman HH, Skodol AE, Lave TR. Revising axis V for DSM-IV: a review of measures of social functioning. *Am J Psychiatry* 1992; 149: 1148-56.
49. Mazza M, De Risio A, Surian L. Selective impairments of theory of mind in people with schizophrenia. *Schizophr Res* 2001; 47: 299-308.
50. Brüne M. "Theory of Mind" in schizophrenia: a review of the literature. *Schizophr Bull* 2005; 31: 21-42.
51. Harrington L, Siegart RJ, McClure J. Theory of mind in schizophrenia: a critical review. *Cogn Neuropsychiatry* 2005; 10: 249-86.
52. Bechi M, Riccaboni R, Ali S, et al. Theory of mind and emotion processing training for patients with schizophrenia: preliminary findings. *Psychiatry Res* 2012; 198: 371-7.
53. Sprong M, Schothorst P, Vos E, Hox J, Van Engeland H. Theory of mind in schizophrenia: meta-analysis. *Br J Psychiatry* 2007; 191: 5-13.
54. Bora E, Gökçen S, Kayahan B, Veznedaroglu B. Deficits of social-cognitive and social-perceptual aspects of theory of mind in remitted patients with schizophrenia: effect of residual symptoms. *J Nerv Ment Dis* 2008; 196: 95-9.
55. Bora E, Yucel M, Pantelis C. Theory of mind impairment in schizophrenia: meta-analysis. *Schizophr Res* 2009; 109: 1-9.
56. Brüne M, Bodenstein L. Proverb comprehension reconsidered – "theory of mind" and the pragmatic use of language in schizophrenia. *Schizophr Res* 2005; 75: 233-9.
57. Schettino A, Lauro LR, Crippa F, Anselmetti S, Cavallaro R, Papagno C. The comprehensions of idiomatic expressions in schizophrenic patients. *Neuropsychologia* 2010; 48: 1032-40.
58. Tavano A, Sponda S, Fabbro F. Specific linguistic and pragmatic deficits in Italian patients with schizophrenia. *Schizophr Res* 2008; 102: 53-62.
59. Roncone R, Falloon RH, Mazza M, et al. Is theory of mind in schizophrenia more strongly associated with clinical and social functioning than with neurocognitive deficits? *Psychopathology* 2002; 35: 280-8.
60. Fett AK, Viechtbauer W, Dominguez MD, et al. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. *Neurosci Biobehav Rev* 2011; 35: 573-88.
61. Lysaker PH, Dimaggio G, Buck KD, et al. Poor insight in schizophrenia: links between different forms of metacognition with awareness of symptoms, treatment need, and consequences of illness. *Compr Psychiatry* 2011; 52: 253-60.
62. Zeppegno P, Gramaglia C, Antona M, et al. Psychopathology, personality and theory of mind in a sample of university students. *Riv Psichiatr* 2014; 49: 132-9.
63. Binz B, Brüne M. Pragmatic language abilities, mentalising skills and executive functioning in schizophrenia spectrum disorder. *Clinical Neuropsychiatry* 2010; 3: 91-9.
64. Hori H, Yoshimura R, Katsuki A, Atake K, Nakamura J. Current pharmacotherapy strategies and considerations for the cognitive dysfunction associated with schizophrenia: a mini review. *Int J Neurother* 2015; 2: 1-3.
65. Rosen A, Hadzi-Pavlovic D, Parker G. The life skills profile: a measure assessing function and disability in schizophrenia. *Schizophr Bull* 1989; 15: 325-37.
66. Wing JK, Beevor AS, Curtis RH, Park SB, Hadden S, Burns A. Health of the Nation Outcome Scales (HoNOS). Research and development. *Br J Psychiatry* 1998; 172: 11-8.
67. Couture SM, Granholm EL, Fish SC. A path model investigation of neurocognition, theory of mind, social competence, negative symptoms and real world functioning in schizophrenia. *Schizophr Bull* 2011; 125: 152-60.
68. Lam BYH, Raine A, Mc Lee T. The relationship between neurocognition and symptomatology in people with schizophrenia: social cognition as the mediator. *BMC Psychiatry* 2014; 14: 138-47.
69. Mehta UM, Bhagyavathi HD, Thirthalli J, Kumar KJ, Gangadhar BN. Neurocognitive predictors of social cognition in remitted schizophrenia. *Psychiatry Res* 2014; 219: 268-74.
70. Moritz S, Andreou C, Schneider BC, et al. Sowing the seeds of doubt: a narrative review on metacognitive training in schizophrenia. *Clinical Psychology Review* 2014; 34: 358-66.
71. Roder V, Mueller DR, Schmidt SJ. Effectiveness of Integrated Psychological Therapy (IPT) for schizophrenia patients: a research update. *Schizophr Bull* 2011; 37 (suppl 2): S71-9.