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Communicative Ability in Schizophrenic Patients: Executive Function, Theory of Mind and Mental Representations

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Abstract

Communication disorders are a typical problem in schizophrenic patients. The aim of the present study is to empirically investigate the role played by a possible deficit in the theory of mind, in the executive function and in the ability to handle sophisticated mental representations in order to explain the poor communicative performance of a group of schizophrenic patients. In particular, we suggest that difficulties in mindreading and in executive functioning are not sufficient to explain communicative deficits in schizophrenia. Our results show the importance of considering the increasing complexity of the mental representations underlying different pragmatic phenomena, a factor that is underestimated in the current literature.

Keywords: Schizophrenia; Communicative ability; Executive function; Theory of mind; Mental representations.

Introduction

Schizophrenia is a complex pathology, in which the distinctive symptoms range from deliria and hallucinations to catatonic behaviour and affectivity problems; in particular a typical disturbance is language deficit (APA, 1994).

Some authors have suggested that this deficit has to be considered as the patient's inability to use language for communicative purposes rather than being related to the syntactic and semantic aspects of language (Andreasen, Hoffman & Grove, 1985). Frith and Allen (1988) also observed that patients' syntactic and semantic abilities remain intact whereas they showed deficits in a more complex use of language. Thus, Frith (1992) concluded that the language deficit typical of schizophrenic patients is principally concerned with pragmatics, i.e., the communicative use of language in a certain context.

According to the present literature, it is possible to identify three principal cognitive components for explaining the communicative deficits in schizophrenia: executive functions, theory of mind (ToM) and inferential processes. Theories based on the first two factors give a global explanation of the deficit, without a fine-grain differentiation between various pragmatic phenomena. Theories based on inferential processes provide a more

articulated differentiation between different pragmatic phenomena but, in our view, they underestimate the role of specific mental cognitive processes, namely the complexity of mental representations in explaining schizophrenic's communicative ability.

The present research is an exploratory investigation aimed at clarifying how the ability to deal with sophisticated mental representations can explain communicative deficits in schizophrenic patients.

In our opinion, executive functions and ToM support communicative ability but they are not sufficient to allow for its realization. In order to fully comprehend human communication it is necessary to consider the mental cognitive processes at the basis of the different pragmatic phenomena. In particular, we suggest that, in order to further explain communicative deficits in schizophrenia, the complexity of mental representations should be considered, in addition to the other two components mentioned above, i.e. executive function and ToM. Thus, we have developed an experimental protocol investigating different communicative phenomena with different degrees of difficulty, which can be explained in terms of the increasing complexity of the mental representations involved. Furthermore, since studies within this area have typically focused on mental cognitive processes underlying the comprehension of a communication act, overlooked linguistic production, our research focuses on the subject's ability to produce a communication act.

The paper is organised as follows. First, we examine how deficits in the executive function and in the ToM abilities could explain communicative deficits in neuropsychological patients. Second, we present our theoretical framework with the intent of specifying how mental representations of increasing complexity can influence different levels of ability in communicative tasks. Third, we present our experiment to test whether the complexity of mental representations involved in communication can help to explain the communicative ability of schizophrenic patients. The paper ends with a general discussion.

Executive functions and communication

The executive function is a cognitive construct used to describe the goal-directed behaviour mediated by the frontal

lobes. The executive function system guides a person's actions enabling him/her to have an adaptive and flexible behaviour. It includes cognitive abilities such as planning, inhibiting dominant responses, flexibility and working memory. From a neuropsychological perspective, frontal lobes are critical to the normal functioning of these abilities. Traumatic brain-injured patients often have damage to this area, and some authors explain the pragmatic deficit displayed by these individuals as being caused by executive function impairment (McDonald & Pearce, 1998). In particular, traumatic brain-injured patients show deficits in the comprehension of conversational implicatures and sarcasm (McDonald, 1992; 1999).

Some studies in the current literature show that schizophrenic patients also show deficits in executive function. For example, schizophrenic patients have an important impairment in their planning ability (Goldberg, Saint-Cyr and Weinberger, 1990) and in visual working memory (Keefe, Lees-Roitman & Drupe, 1997). These cognitive abilities are crucial during a communicative interaction: working memory provides the resources to make the necessary inferences during the comprehension of a discourse while planning allows a person to produce a communication act. These studies overall could suggest that some aspects of the communicative deficits in schizophrenic patients may be due to their principal impairments in executive functioning (see also, Docherty et al., 2000).

Notwithstanding the above, we suggest that an impairment at the executive function level is not sufficient to explain communicative deficits in schizophrenic patients. Indeed, communicative ability can not be reduced to executive functioning. Attention, working, memory and planning abilities support a communicative interaction but more specific cognitive processes are responsible for interpreting communicative exchanges (see the paragraph on the Cognitive Pragmatics theory).

Theory of mind and communication

ToM is the ability to ascribe mental states to oneself and to other people and to use such knowledge to interpret one's own as well as other people's behaviours. Some authors highlight the role of the ToM in human communication (Happé & Loth, 2002; Tirassa, Bosco & Colle, 2006). A developed and intact capacity to mindread is necessary to comprehend a partner's communicative intention.

The relation between ToM and communicative ability is apparent in the autistic pathology. Baron-Cohen, Leslie and Frith (1985) explained how the social and communicative problems, typically demonstrated by these patients, are caused by a ToM deficit. A great number of researchers have found that autistic individuals perform poorly in ToM tasks, starting from the simplest ones, such as the False Belief (Baron-Cohen et al., 1985), to the more sophisticated ones, such as the Strange Stories (Happé, 1994).

The possibility of explaining the typical symptoms of people with autism in terms of mindblindness can also apply, according to Firth (1992), to schizophrenia. Several

empirical studies have shown that schizophrenic individuals perform poorly in both ToM tasks (Doody, Götz, Johnstone, Frith & Cunningham, 1998; Langdon, Davies & Coltheart, 2002) and in the comprehension of communication acts such as indirect speech acts, (Corcoran, Mercer & Frith, 1995), irony and metaphors (Langdon et al., 2002). Some authors have expressed doubts about this theoretical explanation. They claim that the poor performance displayed by schizophrenics in ToM tasks could be due not to their inability to mindread but rather to their primary deficits in executive functions such as planning (Sarfati, Hardy-Bayle, Besche & Widlocher, 1997) and working memory (Drury, Robinson & Birchwood, 1998). At the present time no studies in the literature seem to share a final conclusion about the primary role played by the ToM deficit vs. the executive functioning, in order to explain the poor communicative ability of schizophrenic patients.

Inferential processes and communication

Most authors within the pragmatic domain (Airenti, Bara & Colombetti, 1993; Bara 2007; Searle, 1975; Sperber & Wilson, 1995) point out that communicative understanding is about the expression and interpretation of the intended rather than the literal meaning. Such authors highlight the role of inferential processes underlying a communicative interaction. From this description one can argue that effective communication is achieved when both speaker and listener employ a ToM to understand the ongoing interaction. Nevertheless, we cannot state that the ToM is the unique mechanism in explaining pragmatic performance or that communication can be reduced to the ability to mindread (see Sperber & Wilson, 2002). For instance, the role of cognitive processes other than mindreading in normal human communication was made particularly clear by Sperber & Wilson's Relevance theory (1995). They argue that communication cannot be reduced to a coding/decoding process but that it has to be considered as an intentional behaviour guided by cognitive inferences such as se due to the relevance of the utterance.

Within the general inferential domain, the Cognitive Pragmatics theory identifies specific mental cognitive processes, namely the complexity of mental representations, which allow interlocutors to interpret communicative exchanges. In the next section we briefly explain the theory of Cognitive Pragmatics, which is the theoretical framework we adopted for our study.

Cognitive Pragmatics theory

Cognitive Pragmatics (Airenti et al., 1993; Bara, 2007) is a theory of the cognitive processes underlying human communication that distinguishes between different kinds of communicative phenomena – standard communication acts, deceit, irony– on the basis of the mental representations involved in their comprehension and production. In particular the theory explains and predicts the difficulty in the comprehension of different communication acts in typical development (Bucciarelli, Colle and Bara, 2003) and

autistic children (Bara, Bucciarelli & Colle 2001) and it offers a plausible account for the decay of pragmatic performance in brain-damaged patients (Bara, Tirassa & Zettin, 1997).

A major assumption of the theory is that intentional communication requires behavioural cooperation between two people; this means that when two people communicate they are acting on the basis of a plan that is at least partially shared. Airenti et al. (1993) call this plan a *behaviour game*. A behaviour game is a stereotypical pattern of interaction between the participants in the dialogue. Consider, for example, the communicative exchange:

[1] Alice: 'Could you please lend me Pavarotti's latest CD?'

Bruno: 'Sorry, I haven't listened to it yet.'

In order to fully understand Alice's communicative intention Bruno has to recognise the behaviour game she bids through the communication act. Thus, conversational cooperation requires that Alice and Bruno share the knowledge of the behaviour game at play. In our example:

[2] [LEND-OBJECT]:

- x gives the object to y;
- y returns the object to x.

Behaviour games have a fundamental role in communication: the meaning of any communication act can only be fully understood when the game the move is part of has been clearly identified.

Within the framework of the Cognitive Pragmatics theory, Bucciarelli et al. (2003) focus their attention on factors that affect the differences in the difficulty of comprehending communication acts pertaining to different pragmatic categories, that is standard communication acts (direct and indirect communication acts) and non-standard communication acts (deceit and irony). Mental representations of increasing complexity underlying human communication are not *on-off* phenomena. Indeed the authors found that children show a trend of increasing difficulty in comprehending standard communication acts, deceit and irony and they explain this result on the basis of the complexity of the mental representations involved in such different pragmatic tasks. Moreover, traumatically brain-injured patients (Bara et al., 1997) and autistic children (Bara, et al., 2001) find it easier to comprehend standard communication acts than non-standard acts.

In the present study we propose, and empirically investigate, that the same increase in the complexity of mental representations involves the production of standard, deceitful and ironic communication acts.

In standard communication, default rules of inference are used to understand one another's mental states. Default rules are always valid unless their consequences are explicitly denied (cf. Reiter, 1980). Indeed, in the production of standard communication what the speaker means is in line with his/her private beliefs. Directs speech acts, conventional indirect speech acts and non-conventional indirect speech acts are all examples of standard communication. In terms of mental

representations no conflict is involved: to generate a standard communication act the speaker has merely to produce an utterance that is in line with his private belief and with the behaviour game he is sharing with the partner. Thus, in terms of the complexity of mental representations involved, this is the simplest case we analysed. The following is an example of production of a standard communication act:

[3] *Davide is reading a book while sitting on a carpet in his room. Anna arrives and asks: "Did you go running yesterday evening?"*

Davide answers: "I stayed at home".

On the other hand, non-standard communication, such as deceit and irony, involves the violation of default rules and the occurrence of more sophisticated mental representations. In particular, the production of a non-standard act involves a conflict between the speaker's private mental states and those he communicates to the listener. It follows that non-standard phenomena are more difficult to produce than standard ones. In particular, in the case of production of a deceitful communication act, the speaker has to take into consideration the difference between the mental states that he privately entertains and those he expresses to the partner. The following is an example of production of a deceitful communication act:

[4] *There is an highlighter on Carlo's desk. Federica sees it and, sneakily, puts it in her pocket. Carlo arrives, looks on the desk and asks: "Have you seen my pen over here?"*

Federica answers: "I never saw it".

In addition, along with the above mentioned difference, a statement becomes ironic when the speaker also produces a contrast between the expressed mental states and the scenario provided by the knowledge he shares with the partner. This makes, in terms of the complexity of mental representations involved, an ironic utterance the most difficult phenomenon we investigated. The following is an example of an ironic communication act:

[5] *In a shop, Lara tries on a dress that is clearly too tight and asks Simone: "Does this dress fit me?"*

Simone answers: "It looks too big to me".

Experiment

The present research aims to investigate the ability of schizophrenic patients to produce different communicative phenomena. We propose that executive functions and ToM support communication but specific mental representations, such as those pointed out by the Cognitive Pragmatics theory, modulate communicative ability. Considering the complexity of the mental representations, we expect that, schizophrenic patients find it easier to produce communicative standard acts than non-standard acts. We expect schizophrenic patients to be comparable to normal controls when producing standard communication acts, that involves no conflict between the speaker's private mental states and those he expresses. In contrast, we predict that patients perform worse than controls on non-standard acts,

i.e. deceit and irony, that involve a conflict between the speaker's private mental states and those he expresses. In particular, we predict a trend of difficulty for the schizophrenic patients as regards the production of communication acts, from the easiest to the most difficult: standard communication acts, deceitful communication acts and ironic communication acts.

Material and Procedure

Communicative abilities. The Italian experimental material comprised 12 videotaped scenes, each lasting 20-25 seconds. In each task two actors interacted each producing the same number of words (i.e. 7 ± 2).

This protocol includes *standard communication acts* (4 items), *deceitful communication acts* (4 items) and *ironic communication acts* (4 items). During the task the examiner shows the patient short videotaped scenes where two agents are engaged in a communicative interaction: the first agent asks her interlocutor a question. The patient, assuming the interlocutor's perspective, is requested to produce a communication act in reply.

Considering for example this request to produce a standard communication act used in our experimental protocol:

[6] *Mara and Fabio are in front of an ice-cream shop. Mara asks Fabio: "Which flavour you like?"*

At the end of the scene the experimenter asks the subject: "What could the boy say to her?"

All patients and controls were videotaped. The participants' responses were rated by 2 independent judges blind to the aim of the research and blind to the subject's identity (schizophrenic vs. control). The judges assigned a score of 0 (incorrect) or 1 (correct) to the subject's answer to each item on the basis of the adequacy of the answer within the given context. Examples of correct answers given by patients to this item are: "Strawberry and chocolate!" or "You choose first!". Examples of incorrect answers to the same task are: "You are wonderful today!" or "He's licked it! That's disgusting!". The inter-rater agreement was calculated using Intraclass Correlation Coefficient (ICC), estimated on the means of the total scores for each pragmatic phenomenon. The ICC was 0.71, indicating high inter-raters agreement (Altman, 1991).

Executive functions. The subjects were administered the Trial Making test and the Attentive Matrices for attention abilities, the short version of the Card Sorting Test and the Tower of London for planning abilities, the Verbal and the Spatial Span for working memory and the Immediate and Deferred Recall test for long-term verbal memory.

Theory of mind. The subjects were administered the Smartie's Task, Sally-Ann Task and a selection (6 items) of Strange Stories, excluding the ones that included communication acts like metaphors, deceptions and ironies.

Participants

Fourteen paranoid schizophrenic patients (diagnosed by DSM-IV criteria) were recruited from a local residential mental health care. Patients had a mean age of 37 years

(SD= ± 11.2 ; ranging from 23 to 56 years) and a mean education of 11 years (SD= ± 2.4 ; ranging from 8 to 13 years). There were 12 males and 2 female in our sample. All the patients were Italian native speakers; initial exclusion criteria included leucotomy, neurological disability and a history of drug/alcohol abuse. Fourteen normal controls were matched to the patients group for age, sex and years of formal education.

Psychotic symptoms were assessed by the PANSS (Kay, Fiszbein & Opler, 1987). The mean (\pm SD) PANSS scores for the sample were as follows: PANSS total 87 (± 39); PANSS negative subscale 19 (± 10); PANSS positive subscale 20 (± 10); PANSS general psychopathology subscale 47 (± 22).

All the subjects had to pass a series of neuropsychological tests to rule out the possibility of being too seriously cognitively impaired. The screening battery included the Mini-Mental State Examination, Raven's Coloured Progressive Matrices and the denomination scale of Aachener Aphasia Test.

Results

The results confirm our predictions (see figure 1). In particular, there is no significant difference between patients and controls in the production of standard communication acts (Mann-Whitney test: $z = 1.86$; $p = .19$), whereas patients showed greater difficulty than controls in the production of deceitful communication acts (Mann-Whitney test: $z = 2.84$; $p = .02$), and ironic communication acts (Mann-Whitney test: $z = 3.12$; $p = .001$).

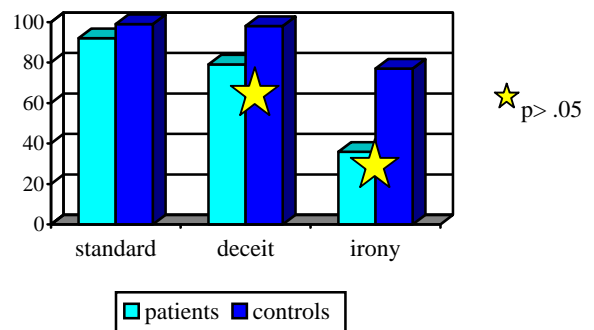


Figure 1: Histogram of the mean percentages of correct responses (patients vs. controls).

Focusing on patients data, and in line with our prediction, we discovered the existence of a trend in difficulty for producing different sort of communication acts, ranging from the easiest to produce to the most difficult: standard, deceitful, and ironic communication acts (Page's L test: $L = 186$; $p < .001$). A detailed analysis reveals that standard communication acts are easier to produce than deceitful communication act (Wilcoxon test: $z = 2.46$; $p = .014$). Moreover, standard communication act is easier to produce than ironic communication acts (Wilcoxon test: $z = 3.11$; $p = .002$). As regards a comparison between deceitful and

ironic communication acts the results reveal that deceitful are easier to produce than ironic communication acts (Wilcoxon test: $z = 2.85$; $p = .004$).

Table 1: Mean percentages of correct responses (patients vs. controls). * $p < 0.5$.

	Patients	Controls
*Attention	53	95
Planning	85	99
* Working Memory	46	84
* Long-Term verbal Memory	47	59
* ToM	69	98

Table 1 shows the scores by both groups on executive function and ToM tasks.

The differences we observed between the performances by patients and controls were in their attention abilities (Mann-Whitney test: $z = 3.99$; $p < .001$), in working memory (Mann-Whitney test: $z = 3.17$; $p = .001$), in long-term memory abilities (Mann-Whitney test: $z = 2.3$; $p = .021$), and ToM (Mann-Whitney test: $z = 4.59$; $p < .001$). On the contrary, we found no significant difference between the two groups' planning abilities (Mann-Whitney test: $z = 2.24$; $p = .094$).

For the patient group we also calculated, the correlation between the ability to produce standard, deceitful and ironic communication acts on one side and executive function or ToM on the other. The correlation was statistically significant between the planning test and the production of standard communication acts (Spearman's rho test: $\rho = .5$; $p = .03$) and deceitful communication acts (Spearman's rho test: $\rho = .46$; $p = .04$). In contrast, there was no significant correlation between planning and irony (Spearman's rho test: $\rho = .05$; $p = .43$). No statistically significant correlations were found between each communicative task (standard, deceit or irony) tested and long term memory, working memory and attention (Spearman's rho test: rho value ranging from 3.83 to .35; p value ranging from $\approx .9$ to $< .2$). We also obtained similar no significant results by analysing the correlation between all ToM tasks and: standard acts (Spearman's rho test: $\rho = 0.01$; $p = .75$) or deceit (Spearman's rho test: $\rho = 0.08$; $p = .95$) or irony (Spearman's rho test: $\rho = 0.49$; $p = .07$).

Conclusions

Empirical studies highlight the role played by ToM and executive function deficits to explain the poor communicative ability of schizophrenic patients. According to our theoretical proposal, in addition to the above-mentioned components, we should consider the complexity of the mental representations underlying different kinds of communication acts in order to better explain patients' unsatisfactory communicative ability. Indeed, according to

our theoretical framework – the Cognitive Pragmatics theory (Airenti et al., 1993) – the production of standard communication acts, involves easier mental representations, whereas other communication acts, such as deceitful and ironic communication acts, involve more sophisticated mental representations.

In line with our proposal, we found that schizophrenic patients show a diversified communicative ability. They do not differ from the control group in the production of standard communication acts, whereas they differ significantly from the normal controls in their ability to produce deceitful and ironic communication acts. In particular, focusing on schizophrenic performance, our data reveal the existence of a trend of increasing difficulty in the production of standard, deceitful and ironic communication acts.

As far as executive functions are concerned, our results show that schizophrenic patients perform as well as the normal matched pairs in planning tasks. However, in line with the literature showing deficit in schizophrenic's planning ability, the percentage of the correct answers show a difference in the expected direction. It is possible that with a greater number of subjects the difference between patients and control could become statistically significant.

The patients show deficits in attention, long term memory and working memory. However, such impairment, can not explain our results, in particular the increasing difficulty shown by schizophrenic patients' in producing standard, deceitful and ironic communication acts. Indeed, all our communicative tasks were built in order to require the same attention level and working memory. Furthermore, all our communicative tasks had the same short duration and therefore did not require long-term memory in order to be solved. In addition, we did not find any significant correlation between such deficitary cognitive abilities and the ability to produce any of the communication acts investigated. As regard planning abilities, we found a statistically significant correlation between planning and the production of standard and deceitful communication acts, but not with the production of irony. However, such correlation can not explain any of our results concerning the different difficulty of the pragmatic phenomena investigated.

As far as ToM is concerned, our results show that schizophrenic patients perform worse than normal controls; this factor helps to explain the difference between the performance by patients and controls in non-standard communicative tasks, i.e. deceit and irony. Indeed, studies in the literature have shown that deceit and irony require ToM (Happé 1993; Winner & Leekam, 1991). One might suppose that the increasing trend of difficulty we observed from standard communication act, to deceit and irony, is exclusively due to the patients' deficit of ToM. However, such explanation, considered alone, is not completely satisfactory. Indeed, neither production of deceitful communication acts, nor production of ironic acts correlate with performance in ToM tasks. To conclude, we do not

wish to deny the role of the ToM in producing ironic or deceitful communication acts but we argue that ToM is not the unique cognitive factor involved in explaining the diversified ability of schizophrenic patients' to produce different sort of pragmatic acts.

Our study highlights the importance of considering all the contributing factors in order to explain communicative deficits in schizophrenia. In particular, our results show the role, in addition to the ToM, played by the complexity of mental representations underlying the ability to produce different communicative phenomena. To conclude, this cognitive factor helps to explain the diversified communicative ability of schizophrenic patients.

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References

- Airenti, G., Bara, B.G. & Colombetti, M. (1993). Conversation and behavior games in the pragmatics of dialogue. *Cognitive Science*, 17, 197-256.
- Altman, D.G. (1991). *Practical Statistics for Medical Research*. Chapman & Hall, London.
- American Psychiatric Association, (1994). *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. Washington, DC: American Psychiatric Association.
- Andreasen, N.C., Hoffman, R.E. & Grove, W.M. (1985). Mapping abnormalities in Language and cognition. In Alpert, A. (Eds.), *Controversies in Schizophrenia*. New York: Guilford Press.
- Bara, B.G. (2007). *Cognitive Pragmatics*. Cambridge, MA: MIT Press.
- Bara, B.G., Bucciarelli, M. & Colle, L. (2001). Communicative abilities in autism. *Brain and Language*, 77, 216-240.
- Bara, B.G., Tirassa, M. & Zettin, M. (1997). Neuropsychological constraint on formal theories of dialogue. *Brain and Language*, 59, 7-49.
- Baron-Cohen, S., Leslie, A. & Frith, U. (1985). Does the autistic child have a Theory of Mind? *Cognition*, 21, 37-46.
- Bucciarelli, M., Colle, L. & Bara, B.G. (2003). How children comprehend speech acts and communicative gestures. *Journal of Pragmatics*, 35, 207-241.
- Corcoran, R., Mercer, G. & Frith, C.D. (1995). Schizophrenia, symptomatology and social inference. *Schizophrenia Research*, 17, 5-13.
- Docherty, N.M., Hall, M.J., Gordinier, S.W., & Cutting, L.P. (2000). Conceptual sequencing and disordered speech in schizophrenia. *Schizophrenia Bulletin*, 26, 723-735.
- Doody, G.A., Götz, M., Johnstone, E. C., Frith, C.D. & Cunningham, O. (1998). Theory of Mind and psychoses. *Psychological Medicine*, 28, 397-405.
- Drury, V.M., Robinson, E. J. & Birchwood, M. (1998). Theory of mind' skills during acute episode of psychosis and following recovery. *Psychological Medicine*, 28, 1101-1112.
- Frith, C.D. (1992). *The Cognitive Neuropsychology of Schizophrenia*. Hove, UK: Erlbaum.
- Frith, C.D. & Allen, H. A. (1988). Language disorders in schizophrenia and their implications for neuropsychology. In Bebbington, P. McGuffin, P. (Eds). *Schizophrenia*. Heinemann, Oxford.
- Goldberg, T.E., Saint-Cyr, J.A. & Weinberger, R. (1990). Assessment of procedural learning and problem solving in Schizophrenic patients by Tower Hanoi type tasks. *The Journal of Neuropsychiatry and Clinical Neurosciences*, 2, 165-173.
- Happé, F. (1993). Communicative competence and theory of mind in autism : A test of Relevance theory. *Cognition*, 48, 101-119.
- Happé, F. (1994). An advanced test of Theory of Mind. *Journal of autism and developmental disorders*, 24, 129-154.
- Happé, F. & Loth, E. (2002). Theory of Mind and tracking Speaker's Intentions. *Mind and Language*, 17, 24-36.
- Keefe, R.S., Lees-Roitman, S.E. & Dupre, R. L. (1997). Performance of patients with schizophrenia on a pen and paper visuospatial working memory short delay. *Schizophrenia research*, 26, 9-14.
- Kay S.R., Fiszbein A. & Opler L.A. (1987). The Positive and Negative Syndrome Scale (PANSS) for schizophrenia. *Schizophrenia Bull*, 13,261.
- Langdon, R., Davies, M. & Coltheart, M. (2002). Understanding minds and Understanding Communicated meanings in Schizophrenia. *Mind and Language*, 17, 68-104.
- McDonald, S. (1992). Differential pragmatic language loss following severe closed head injury. *Applied Psycholinguistics*, 13, 295-321.
- McDonald, S. (1999). Exploring the process on inference generation in sarcasm. *Brain and Language*, 68, 486-506.
- McDonald, S. & Pearce, S. (1998). Requests that overcome listener reluctance. *Brain and Language*, 6, 88-104.
- Reiter, R. (1980). A logic for default reasoning. *Artificial Intelligence*, 13, 81-132.
- Sarfati, Y., Hardy-Bayle, M.C., Besche, C. & Widlocher, D. (1997). Attribution of intentions to others in people with schizophrenia. *Schizophrenia Research*, 25, 199-209.
- Searle, J.R. (1975). Indirect speech acts. In P. Cole & J. L. Morgan (Eds.), *Syntax and semantics 3: Speech acts*. New York: Academic Press.
- Sperber, D. & Wilson, D. (1995). *Relevance: Communication and Cognition*. Basil Blackwell: Oxford.
- Sperber, D. & Wilson, D. (2002). Pragmatics, Modularity and Mind-reading. *Mind and Language*, 17, 3-23.
- Tirassa M, Bosco F.M. & Colle L. (2006). Sharedness and privateness in human early social life, *Cognitive Systems Research*, 7, 128-139.
- Winner, E. & Leekam, S. (1991). Distinguishing irony from deception. *British journal of developmental psychology*, 9, 257-270.