An inter-subjective perspective on negative symptoms of schizophrenia: Implications of simulation theory

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Abstract

The majority of neurocognitive models of negative symptoms in schizophrenia focus on failures to construct and sustain accurate representations of others and the world. Rarely considered are the inter-subjective dimensions of negative symptoms as well as the mechanisms that sustain such symptoms. This paper critically analyzes neurocognitive models of schizophrenia based on Theory of Mind (TOM) deficits and describes an alternative model of negative symptoms of schizophrenia based on Simulation Theory. We assert that several forms of negative symptoms of schizophrenia can be explained by an inability to express oneself, participate in, or be attuned to the context of social interactions. We label this deficit: *disadherence* and suggest it may result from dysfunctions in "mirror" neurons. In particular, we suggest that patients with schizophrenia are unable to construct an inner model of the mind of another person and "select," from among various hypotheses, the one most suited to immediately understand the meanings and goals of interpersonal interactions. Moreover dysfunction in both "canonical" and "mirror" neurons, situated for the most part in the premotor and parietal cortex could cause psychomotor negative symptoms. These hypotheses are explored in the context of a single case study.

Introduction

Paucity of self-expression and failures to sustain social relations are key elements or symptoms of schizophrenia, especially in the post acute phases of disorder. As noted in the literature since the coining of the term schizophrenia (Bleuler, 1911/1950), and included as forms of negative symptoms, these include enduring struggles to express one's own emotion, to understand others' emotions, intentions, and communications, and an inability to find interactions pleasurable or rewarding (APA, 2001). To date, research suggests that greater levels of social dysfunction in schizophrenia are linked with impairments in neurocognition (Addington & Addington, 1998; Brekke, Raine, Ansel, Lencz, & Bird, 1997; Mueser, Bellack, Douglas & Wade, 1992). Importantly it has been suggested that neurocognitive impairments do not diminish the need for closeness with others (Lysaker, Wickett, Lancaster, Campbell & Davis, 2004) but seem instead to limit a person's capacities to express and understand the meanings inherent in social situations (Bryson, Bell, Lysaker & Kaplan, 1997; Greig, Bryson & Bell 2004; Langdon, Coltheart, Ward & Catts, 2001; Lancaster, Evans, Bond & Lysaker, 2003).

While these studies are consistent with hypotheses that impairments in neurocognitive function limit social function (Green, 1996), they leave us with the question of how this occurs within the consciousness of an individual. How do neurocognitive impairments prevent persons from successfully expressing themselves and relating to others at the level of subjective experience? To date, one of the most popular explanations for the causes of these forms of negative symptoms has been proposed by Frith (1992, 1994). Frith claims that these stem from neurocognitive deficits in the ability to represent others' intentions to oneself; that is, to interpret the meaning of others' actions and that this makes it impossible to generate hypotheses about what others think or feel. Put another way, social interactions are

incomprehensible because the person with schizophrenia cannot form a theory of the other's mind or intentions.

While this position is intuitively appealing, it has recently been criticized. Despite prominent symptoms, many patients with schizophrenia can understand the emotions of others in certain situations and may not only understand but excessively monitor aspects of their own thoughts (Sass, 1992; Stanghellini, 2004). Beyond this, Frith's model seems to explain symptoms and deficits in purely intra-personal terms. The individual appears to be regarded as an isolated system which either possesses or does not possess sufficient knowledge about him or herself and others. Performance in social relations is posited to proceed on the basis of this knowledge and to be successful if the representations formed are sufficiently accurate. The model thus does not take into account intersubjective processes or those processes that occur in inter-personal relationships when two persons come to know and jointly make meanings or interpretations.

In this paper we accordingly propose an alternative hypothesis. We suggest that a range of negative symptoms in schizophrenia including a) poverty of speech and action and b) difficulties establishing and sustaining inter-subjectivity, can be understood differently in light of Simulation Theory (Goldman, 1992; Heal, 1994, 1995, 1996; Gordon, 1995a; 1995b; 1996; Harris, 1995; Jannerod & Pacherie, 2004). Specifically we suggest both of these difficulties may result from a dysfunction in specific neural processes which are required for individuals to form goal-oriented action plans and internal models of another's goal-oriented actions. Particularly, we hypothesize that in inter-subjective experiences, patients with negative symptoms build many different hypotheses about the thoughts and intentions and meanings of another but lack a mechanism that rapidly and automatically eliminates implausible hypotheses. As a result there are too many hypotheses to consider and the patient experiences hyperarousal and consequently withdraws. The result is an inability to be

involved in the interpersonal context and pragmatically understand it, a problem which we will term "disadherence" to context.

To explore this hypothesis, we first illustrate the negative symptoms in question with a case study of a man who experiences both an inability to express himself and to sustain relationships. We next present the model of the neurobiological bases for the experience. We contrast our view with Frith's one, based on a Theory of Mind's (TOM) deficit. Finally we explore how the neurobiological processes we describe might be used to understand the phenomenon found in our case study.

Alberto's case[1]

Alberto is 28 years old and has a high school degree. He is the first of three children. Neither his adult brother nor adolescent sister has ever reported psychiatric problems. His mother has been diagnosed in the past as suffering from psychosis and Alberto recalls that she did not often take care of him as he grew up. He has few memories of his father and describes him as having a benevolent but limited role in his life.

The patient's problems began, by his account, when he was in lower middle school. At that time he experienced considerable emotional distress secondary to what he recalls as the ill-treatment he received from classmates. At the age of 20 he was hospitalised for the first time with persecutory delusions and auditory hallucinations which included voices talking to each other. The emergence of these symptoms may have been precipitated by occasional use of cannabis. At the time of referral, Alberto reported adherence to medication and his positive symptoms disappeared after several weeks of treatment. By contrast, since his hospitalization Alberto has experienced increasing levels of estrangement from others.

Alberto presents a range of negative symptoms. Typically, he makes few gestures or goal-oriented actions. When he speaks, there are long latencies between words and he

[1] fictitious name.

displays little interest or pleasure in anything, appearing generally indifferent and having poor social skills. He also presents many typical negative symptoms: apathy, anhedonia, social withdrawal, and deficient attention. Two independent psychiatrists at the same Centre (the one following the patient in the assessment phase and the psychotherapist) established, through a clinical interview, the DSM IV diagnosis of schizophrenia residual type (American Psychiatric Association, 1994).

When he describes his difficulties with daily life, Alberto relates that his primary concern is his difficulty grasping the meaning of others' words and actions. He is aware that others are trying to communicate with him but cannot understand what they are trying to say. In the following segment early in his therapy, Alberto describes this process in detail:

> A: …because every time… when I'm involved (unintelligible) it gets to a certain point where I'm unable to follow what's being said and then I just fly off the handle… like yesterday. I started arguing with this guy because at a certain point he says 'I'm going to beat your head in'. Well, I couldn't tell if he was saying it jokingly or if he really meant it… and so I started swearing and then I left…because at a certain point I go really out of control…
>
> Therapist: um
>
> A: Every time I come here too and start laughing… I've no idea myself why I laugh… I laugh to stop myself crying… but who knows…
>
> Therapist: I've thought about this a bit, nevertheless, and I've realised that these bouts of anger happen to you almost always on the occurrence of situations like the one you've told me about, that is when you need… - how can I say? - to interact with someone… do you understand what I mean?
>
> A: Ah, yes!

Therapist: that is… it's not that you're alone, watching television or listening to music and then at a certain point you get angry… or with a friend, or as you told me over the telephone (unintelligible) they're watching you

A: another… we crossed each other's paths and then at a certain point he says to me "What do you want?"

Therapist: There you are, you see?

A: … Then I saw him a week later… I started an argument… it was by mistake like… and the guy was making signs at me. Then I went up to him and I was swearing and using bad language (pause) and after that… that was all that happened.

Therapist: Yes

A: After that I went to E (a district)… and then at a certain point I said, 'the more people get on your tits and the more you find them around you'… at a certain point (pause) but I'm not joking, I really said it …

Therapist: And I know you did, because you were angry

A: … He'd got on my tits

Therapist: um… but you said something that's made me think a bit… you said, 'he said I'm going to beat your head in…" and you told me 'I couldn't tell if he was saying it jokingly or if he really meant it'

A: Ah, in fact I couldn't tell

Therapist: And you're still asking yourself. You haven't understood…

A: yep… Ah yes, because with another employee at my firm… like I had this argument with him because he'd said something else to me but now I can't remember

Therapist: um… that is it can happen that someone says something to you and you don't understand…

A: … I understand something completely different…

Therapist: You mean you're unable to understand what they mean?

A: I'm unable to understand what the other person's trying to say…

Therapist: And how do you feel when you can't understand?

A: Who knows.

Therapist: What?

A: I don't even know myself.

Simulation theory: basic principles

In order to understand how Alberto and others faced with his dilemmas might be so unable to express themselves or understand the meanings of others, we turn to Simulation theories (ST; Goldman, 1992; Heal, 1994, 1995, 1996; Gordon, 1995a; 1995b; 1996; Harris, 1995; Jannerod & Pacherie, 2004). According to ST, our awareness of others' minds is based on an innate ability to use our experience as a model. Understanding others' minds (and, consequently, the meaning of their communications) is based on implicit, non-conscious action or "simulation" processes. Simulation Theory has gained acceptance after the discovery of two specific forms of neural activity, both situated for the most part in the premotor and parietal cortex, which could mediate such simulation processes. The first is carried out by neurons labelled *canonical neurons*.These neurons are activated when an individual carries out a goal-directed action with an object (e.g. grasps it). The same neurons are also activated when an individual remains still but the same object is merely shown to him or her, without the action being actually undertaken (Rizzolatti & Fadiga, 1998; Gallese, 2000, 2001, 2003; Murata et al. 1997; Rizzolatti, Fogassi & Gallese, 2002)[2]. In both cases the characteristics of the object activate a plan of action for achieving a specific goal. This

[2] Rizzolatti & Fadiga (1998) discovered neurons with such characteristics recording single-neurons electrical activity in the monkey's rostroventral premotor cortex. The same kinds of neurons were observed in humans on the basis of brain imaging evidences (see Rizzolatti, Fogassi & Gallese, 2002).

system, therefore, allows individuals to continuously simulate the actions required to effectively interact with objects in their world.

The second type of simulation process proposed by ST is facilitated by *mirror neurons.* These are activated, as in the first case, in order to carry out an action with a specific object in mind. Unlike canonical neurons, mirror neurons fire when the persons see another individual carrying out that same action[3]. That is, observing an action produces a similar pattern of neural activation as would accompany the actual performance of that action (Gallese, 2000, 2001, 2003; Rizzolatti, Fadiga, Fogassi & Gallese, 2001; Rizzolatti, et al., 2002). According to Gallese and Goldman (1998), mirror neurons form a cortical system matching observation and execution of goal-related motor actions, allowing for coordination between perception and action.

Taken together, canonical and mirror neurons mediate the simulation processes as individuals act in the world, but in different contexts. First, acting together they simulate action in an individual-object context. Second the mirror system alone does the same but in an individual-individual context (Gallese, 2000, 2001, 2002). In both cases the simulation occurs in response to current action-related visual stimuli (an object or a peer) and represents the action and its consequences prior to it actually being carried out. This makes it possible to make timely corrections to errors, adapt actions to the contingent context, and more effectively pursue goals. At a neural level we "simulate" goal-directed actions (a) which are oriented by the physical features of the contingent context, and (b) when we see a peer carrying it out (Gallese, 2000).

Gallese considers simulation to be an anticipatory mechanism (forward model), suitable for predicting consequences of actions before they are undertaken or while they are

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being carried out. Besides this function, the mirror systems may constitute the neural basis of inter-subjectivity. These neurons make it possible to deduce the goals of others' actions by codifying the goals of another's actions by an observer. Humans recognize other humans via the creation of a "we-centric" space, the "shared manifold of inter-subjectivity" (Gallese, 2001; 2003) which is based on the activity of mirror neurons. Many possible dimensions of interpersonal interaction, regardless of complexity, likely derive from the same functional process: the embodied simulation carried out by mirror neurons. Thus the sensory-motor integration carried out by the canonical and mirror neurons determines "simulations" of action, which allows executive control of those same actions and for an understanding to develop when others perform those actions (see Figure 1).

Insert figure 1 about here.

Simulation theory and the neurobiology of poverty of speech and action

Gallese speculates that schizophrenia involves damage to the multidimensional neuronal simulation processes that support the shared manifold of inter-subjectivity (Gallese, 2003). In this work, we extend this speculation by suggesting that damage to the two neural systems involved in action simulation could explain several forms of negative symptoms in schizophrenia. Specifically we first suggest that impoverished speech and action could result from dysfunction in the neural simulations with the task of controlling goal-directed action (canonical and mirror neurons).

We propose that a dysfunction in canonical and/or mirror patterns determines a lack of forward modelling and prevents individuals, prior to or while taking action, from simulating in advance the initial and following stages of their planned action. Such dysfunction prevents individuals from: a) starting that action in the most effective manner, b) making timely corrections to errors and c) monitoring *on line* the action in order to adapt step by step to what is emerging in the immediate context during the action itself. A dysfunction

in this system could thus reduce spontaneous motions and coordination of movements, leading persons to experience difficulty initiating action. As a whole this could hypothetically result in impoverished goal-oriented actions similar to those experienced by Alberto: limited gestures and poor speech leading to long latencies between words.

We propose that a dysfunction in mirror patterns alone could have another consequence: it may stop an individual from creating plans for action that fit the goals emerging in an individual-individual context, and comprehending the ongoing actions of others. In the following section we present some evidence that 'actions' simulated by mirror neurons also include the signals (conventional signs, phrases, communications involving irony, expressive behaviour, etc.) mediating the meanings taking shape in an inter-subjective space.

Simulation processes, inter-subjectivity and understanding of other's mind

Alberto not only feels unable to act but he also does not feel attuned with others. He cannot enter the intersubjective space. We hypothesize that this second series of symptoms results from a dysfunction of a mechanism that allows persons to immediately select a working hypothesis about the meanings of others' behaviour during the interaction (mirror neurons).

Mirror neuron activities have a prominent role in the understanding of another's mind. In accordance with Gallese (2001), we maintain that more complex operations than actions in an inter-subjective space are mediated by mirror neurons:

a) Context and intention: In a recent fRMN imaging study of 23 subjects, Iacoboni and colleagues (2005) found that premotor mirror neuron areas[4] which usually activate when observing an action present a notable RMN signal increase when that action takes place in a context that suggest that action was driven by a particular intention (e.g. taking a glass from a

[4] One of the areas presenting the most relevant signal increase was the pars opercularis of the inferior frontal gyrus.

dinner table in order to help clean up after dinner). The authors conclude that when the action takes place in a specific context, not only are mirror neurons activated, simulating that action but also a second pattern of mirror neurons are activated, programming the series of actions that most likely, in that context, will follow the initial action. The activation of this second pattern determines the RMN signal increase. For example, looking at someone grabbing a glass from a sumptuously adorned table will activate the mirror pattern relative to the action of grabbing, along with a second mirror pattern able to plan the action of bringing the glass close to the mouth and of drinking (Iacoboni et al., 2005). In other words, mirror simulation systems may decode possible intentions connected to the goal-oriented action by interpreting the context.

b) Sensation and emotion. Singer and colleagues (2004) investigated the brain activity by fRMN imaging in 16 couples of volunteers. The brain activity of a female observing her partner experiencing a painful stimulus was compared to one elicited when she was the one experiencing the painful stimulus. Results showed that some brain areas[5] were activated in both situations, and this common activation pattern correlated with individual empathy scores. The authors conclude that there is true empathy for somatic pain: observing the pain expressed by a peer causes us to simulate the sensations and emotions connected to that pain. Similarly, an fMRI study by Wicker and colleagues (2003) demonstrated that the same areas of the brain (i.e. the insula and anterior cingulate cortex) are activated when disgust is experienced and when facial expressions of disgust are observed. The substantial convergence between the neural structures activated during the subjective experience of sensations and emotions, and those activated when we are decoding those same sensations and emotions in others, supports the idea that the human brain contains a wide number of mirror systems carrying out

[5] Bilateral anterior insula, rostral anterior cingulated cortex, brainstem and cerebellum.

simulation routines in various inter-subjective transaction dimensions (imitation, imagination, empathy).

c) Communication and language. Several theoreticians consider that internal motor programs are not only the best way possible of controlling motor actions themselves but can also provide a basis for more complex domains such as communication (Wolpert, Ghahramani & Jordan, 1995, Kawato, 1997, 1999). Those theories are confirmed by the presence of "communicative mirror neurons" in monkeys which discharge while a monkey observes another monkey making communicative gestures such as tongue or lips protrusion (Ferrari, Gallese, Rizzolatti & Fogassi, 2003). In the same way, in humans, the presence of silent speech activates mirror neural patterns with a communicative function, mostly localized in the premotor sector of Broca's area (Ferrari et al., 2003). Gallese and Lakoff (in press) hypothesize that simulation processes of intentional actions have a relevant role even in the comprehension of language signs:

> "[…] in the case of the concept of *grasping*, one would expect the parietal-premotor [mirror] circuits that form functional clusters for grasping to be active not only when actually grasping, but also when understanding sentences involving the concept of *grasping."*

Consistent with this, others have shown through fRMN brain imaging that the mirror neuron system is activated by action-related sentences (Tettamanti, Buccino, Saccuman et al., 2004). That may point to the possibility that linguistic and paralinguistic understanding could be based upon the same neural processes which mediate goal-oriented motor action understanding[6]. This assumption seems to be corroborated by some data showing that we tend to accompany our understanding of language or any imaginary activities with bodily reactions

[6] In the case of linguistic understanding, this theoretical position seems incompatible with the distinction between semantic and pragmatic understanding; i.e. it is in contrast with several neurocognitive models of semantic processing, postulating that syntactic, semantic and pragmatic processing depend on the activation of mutually independent neural models (Frazier, 1987; Frazier & Rayner, 1987; Friederici, 2002).

simulating real experiences (Johnson, 1987; Glenberg, 1997; for a review, see also Jannerod & Pacherie, 2004).

According to this perspective, simulation neural processes are necessary for decoding intentions, sensations, emotions, communicative and linguistic signals of others during interactions. The simulation processes thus mediate our understanding of others' thoughts and emotions during interactions. This perspective is part of a more general theoretical paradigm which focuses on the inter-subjective dimension of the construction of the understanding of mind. It represents an antithesis of classical cognitive science which, on the basis of the epistemological individualism inherited from Cartesian philosophy, considers the individual an information elaboration system; namely, a disembodied set of computational processes not situated in social contexts (Sinha, 2001). According to classical cognitive science, these computational processes operate on social and physical contexts which have no part in the processes themselves[7]. In the context of the understanding of another's mind, Theory of Mind theorists start from this paradigm. They consider another's (and their own) mind understanding as a knowledge which is similar to scientific paradigms (Gopnik, 1993; Gopnik & Wellman, 1992, 1994; Wellman, 1990). In other words, individuals can understand another's mental events and actions because they possess a personal "body of rules or principles or propositions" (Stich & Nicols, 1992, p. 35), a theory which can be utilized in order to make inferences, or to explain events and actions. In this article we do not critically analyse the Theory of Mind perspective or the paradigm from which it is derived, but we do suggest that it fails to examine several important aspects of social relations**,** (e.g. "the sense of identity that we experience with the multiplicity of 'other selves' populating our social world;" Gallese, 2005, p. 30).

[7] The difference we briefly describe here between the - individualist - classical cognitive science and the - inter-subjectivist - "second generation cognitive science" reflects the "second cognitive revolution" namely, the paradigm shift that occurred in cognitive science in the last decade of the 20th century (see Harrè & Gillet, 1994; Sinha, 2001).

Others (Carpendale & Lewis, 2004; Merleau-Ponty, 1945/1962; Husserl, 1989; Lakoff, 1987; Gallese & Lakoff, 2005) employing the inter-subjective paradigm maintain that the mind does not process information in an isolated way. They assert to the contrary that such elaboration is *embodied*; namely, that it is possible to explain it only if one recognizes that the individual who elaborates information has (is) a body, and that this body is continuously involved in a stream of exchanges with other minds which are embodied, too. Following this paradigm, many have investigated how we understand others, criticizing the individualistic paradigm of TOM theorists and postulating that the understanding of another's mind and actions takes form within inter-subjective interactions (Chapman, 1988; Tomasello, Carpenter, Call, Behne & Moll, 2005; Vygotsky, 1998; c.f. Carpendale & Lewis, 2004). During these interactions, the individual would not take information concerning another's mind from a "depot" of theoretical knowledge. Instead, the contingent interaction would activate automatic mental representations and bodily reactions in the individual, and these representations and reactions would mediate the understanding of another's mind and actions (Preston & De Waal, 2002).

Simulation, context and disadherence

Inter-subjective transactions develop in what Gallese (2001) defines "identity" space. This space takes form by virtue of the individuals involved in a transaction who perceive that she/he and the other have (are) a living and acting body[8]. The "identity" space takes form from action simulations which are reciprocally elicited by gestures, postures, words, etc., and which continuously indicate the co-presence of living and thinking bodies. The identity space is the background of the communicative exchange and of the mutual understanding of

[8] This perspective is consistent with Husserl (1989), in the sense that what makes the other understandable to us at a basic level is just that we do not experience other's body as a material object (*Körper*), but as something alive and acting (*Leib*), just like our own body.

symbolic signals (verbal and non-verbal): an inter-subjective "shared semantic context" (Gallese, 2003). According to this theoretical background and the data we have presented above, we make the following speculation: this semantic context takes form progressively over time.

The process of mutual understanding, the linguistic and paralinguistic signals exchanged during an inter-subjective transaction, and of inserting signals in the right context, is co-construed *on line* by the "actors" of the transaction itself. We propose a two-phase model: at the beginning of the interaction, the individual engaged in the interaction goes through a "generalized" cognitive "activation state" (Salvatore, 2004), in which he or she automatically gives many different meanings to another's initial communicative signal and every meaning is equally plausible. The individual would then emerge from this state of generalized activation by a selection mechanism, which is based on a simulation of the processes embodied in the other's mind. In other words, when an individual looks at another who is saying something and demonstrating specific expressive behaviours, the observer shows a pattern of brain activity which mirrors what would occur if it was him or her speaking or making those expressions. This automatic simulation allows possible hypotheses to be selected from a general pool based on internal experience. Processes of logical-deductive reasoning can then complete the work of selection amongst this reduced pool of "residual" hypotheses.

On the basis of the selection operation, the individual is better able to decide in the unfolding interaction what to communicate to the other, and as quickly and progressively the shared semantic context of the interaction takes form. For example, an individual easily realizes that if a friend smiles, tells her he is hungry and proposes that they go together to a pizzeria nearby, he is inviting her to spend the evening together eating pizza, rather than proposing to have her help in writing an article about the quality of the food at that restaurant.

With the background of the body identity space (which in this case, both persons being hungry has a relevant role), the individual selects amongst different plausible hypotheses about the meaning of the other's communications, the one which is made relevant by the eating-pizza-together-in-a-pizzeria action simulation. Also the other person (smiling and talking about the pizzeria), in order to monitor the state of her/his actions, acts next in accordance with what they understand to be the meaning of the individual's answer. Then the "actors" of the interaction progressively develop a mutual knowledge about the other's goals. Gradually, as the transaction goes on, the level of ambiguity of the meaning of the communicative signals is reduced, so that the "actors" are able to assume a clear and socially shared meaning and to reach a shared goal (Tomasello et al., 2005). In our example this would be to go to the same pizzeria at the same time and to eat pizza.

In the interview extract presented earlier, it appears that Alberto is not having difficulty making hypotheses about the other but rather difficulty in selecting among the hypotheses. He seems unable to select, amongst the many "activated" meanings, the most plausible one. Alberto considers the possibility that the other has said something ("I'm going to beat your head in") as a joke, but this hypothesis does not acquire that priority compared with other hypotheses. Alberto here suffers from a limited ability to "select" the meaning (action) relevant to the context and most in tune with the goals of the inter-subjective transaction underway. This leads to a disadherence with the context. As a result, he cannot grasp the meaning of others' actions. In terms of ST, maybe Alberto does not also experience the sense of body "identity" with the other and as a result is incapable of engaging in a shared manifold of intersubjectity.

From this perspective, we share Gallese's view that schizophrenia involves damage to the neuronal simulation processes that support the shared semantic context taking form in inter-subjective transactions (Gallese, 2003) but hypothesise further, on the basis of a qualitative

clinical analysis, that particular negative symptoms have a more specific cause, namely, a dysfunction in simulation-mediated processes of selection of congruent hypotheses about the other's pragmatic communicative goal. Moreover, our view includes the relevant role of canonical neurons' dysfunction in determining impoverished goal-oriented actions, a role not postulated by Gallese.

Finally, the feedback that Alberto gives the other is impoverished and this makes it difficult for the other to simulate Alberto's actions and goals. For the other, it is difficult to interact and to remain involved in the relationship, so the other may stop giving positive and clear communicative signals. It is also possible that the other will give negative feedback in the hope of escaping from the interaction. So Alberto will remain in the initial generalized cognitive activation state and will not understand the meaning of the transaction. This result, and the consequent negative arousal, leads Alberto to experience negative emotions (anger) and to decide to escape from the relationship.

In general, we maintain that persons like Alberto are unable to pass from a state of generalized activation to primary extractions of consistent meaning; that is, those extractions on which, as an interaction gradually evolves, a coherent semantic context identity with another is built. Such a hypothesis is consistent with not only the empirical research noted above but also phenomenological analyses of schizophrenia (Binswanger, 1960, 1965; Blankenburg, 1971; Callieri, 1982; Merleau-Ponty, 1945/1962; Mundt, 1990; Paci 1990; Rümke, 1942; Stanghellini, 2000, 2001), which stress that excessive self experience makes it impossible to take part in an inter-subjective construction of a semantic context.

Importantly, it is not that Alberto cannot represent or understand the meaning of anothers' actions. Alberto does not seem to show a TOM deficit (Frith, 1992; 1994). On the contrary, he seems to show a TOM hypertrophy. He makes too many hypotheses and is unable to make a choice amongst them. This matter leads us to a relevant remark on Frith's model.

A comparison with Frith's neuropsychological model

Frith (1992, 1994) has tried to understand the neuropsychological bases of thought disorder, positive symptoms as well as negative symptoms closely related to social dysfunction in schizophrenia. He explains social withdrawal results from the combination of a lack of self-generated "communicational" actions and an inability to interpret others' behaviour and emotions. Applied to Alberto's report, this would seem to suggest this withdrawal occurs because he cannot generate communicational actions nor interpret the communications of others.

Contrary to this, however, Alberto does form sophisticated hypotheses about others' intentions: the other person is joking or deliberately trying to offend him ("I couldn't tell if he was saying it jokingly or if he really meant it"). He has ideas about what thoughts others may have and recognizes well enough his own intentions and their possible consequences. What he cannot experience is that automatic, pre-reflective state of mind that allows him to determine if a specific hypothesis about another's intention fits the specific inter-subjective contingent context. Alberto cannot find the meaning and engage in a meaningful dialogue with the other. This problem is not accounted for by the Frith model.

In Alberto's case, we see an example of withdrawal from relationships which seems to have completely different roots from those proposed by Frith: he seems to be unsuccessful in inter-subjective transactions not because he fails to ascribe intentionality to the other, but because he cannot grasp the meanings regulating the context of the current relationship and creating an inter-subjective space (Carpendale & Lewis, 2004; Gallese, 2001; Tomasello et al., 2005).

Patients like Alberto, when involved in an inter-subjective transaction, seem - metaphorically - to persistently ask themselves: "Others possess mental states (intentions, beliefs, desires) *a,b,c,d…x,y,z*, and any of these might be the cause here and now of their

actions... but which of these mental states is in fact activated at this moment?" In other words, they are able to pre-reflectively (at a neural level) construct different hypotheses about the mental state of the other person but not pre-reflectively select the right answer among all the various possibilities. They recognize a multitude of possibilities but all seem equally likely. Given this, we assert that persons with these types of negative symptoms in schizophrenia possess a Theory of Mind but are unable to make a pragmatic use of it[9]. This gives rise to a chronic disadherence within any current relationship.

Our model assumes that such disadherence also depends on how difficult the individual finds it to understand the pragmatic contest (the goal) of the current relationship. Pre-reflective simulation processes can be more effective during an interaction with others who are more familial, or about more familial themes. In general, it is possible to hypothesize a variable effectiveness of these processes and, consequently, of disadherence. This hypothesis can explain the data emerging from a recent meta-analysis of 30 studies of TOM deficit and schizophrenia by Harrington and colleagues (2005). This study revealed that while there is a trend suggesting an impairment of TOM abilities in patients with schizophrenia, the association of TOM abilities to symptoms varied from study to study. According to our view, these inconsistencies may reflect: a) that experimental contexts are themselves inter-subjective transactions which present differing levels of complexity and challenge for patients with schizophrenia seeking to understand them (task intrinsic difficulty, examiner's communicational abilities, etc.); and b) that TOM itself is an ability which is strictly dependent on the nature of the contingent context. We consider TOM an ability which may change according to what happens in the contingent interaction.

Finally, our view also starts from the neurobiological data about the complex inter-subjective domains and mirror neurons activity. This approach makes it possible to solve a

[9] In this perspective, the TOM theorists (including Frith), do not show an entirely coherent approach to the problem: some of them, though postulating that schizophrenia patients suffer from a deficit in TOM module, show that they do not fail at all in tasks testing that capacity (Frith, 1994; Frith & Corcoran, 1996).

broader theoretical problem in Frith's neurocognitive theory, which extends the hypotheses about action dysfunctions to complex psychological dimensions like language and emotions, but without any neuro-biological basis[10].

Disadherence and negative symptoms

On the basis described in the previous sections, many of Alberto's inter-subjective negative symptoms become easier to explain. We hypothesize that his chronic disadherence to the pragmatic communicational context (let us recall Alberto's words: "because every time… when I'm involved… it gets to a certain point where I'm unable to follow what's being said and…") causes frequent increases of disorganized arousal during inter-subjective transactions. In order to avoid a disregulated increase in the arousal at this point, Alberto takes action which disrupts the interaction ("…and then I just fly off the handle"; "I started swearing and then I left"; "Then I went up to him and I was swearing and using bad language (pause) and after that…that was all that happened"). The contingent reduction of the arousal determines a self-reinforcement of the social withdrawal. Consistent with this, Costello (1993) has suggested that social withdrawal is a protective reaction that reduces arousal during social interaction, while Lysaker and colleagues (2005, in press) have provided further case analyses of the extreme discomfort wrought by inter-subjectivity. It is clear that if such situations are repeated frequently, social withdrawal can become habitual, generating social disability. Consistent with this, some authors have found that social withdrawal and deficit in social skills exacerbate each other (see Falloon & Marshall, 1983 for an empirical confirmation). The impoverishment of motor and speech action, which hampers the carrying out, in interaction, of

[10] Also, in his more recent work, Frith (2005) continues on the track of his neuropsychological model of schizophrenic symptoms: he investigates the neural basis of symptoms in the field of "alien control", in which the patient attributes his own actions to another agent. This may be based on a failure to integrate information generated in frontal cortex (goal-oriented action) with information generated in posterior cortical regions (sensory processing). Thus Frith does not investigate the neural basis of the relationship between goal-oriented action and more complex and intersubjective psychological dimensions that concern us.

behaviour that would assist in developing relationships, also plays a part in the decline in social ability present in Alberto.

This kind of explanation of negative symptoms, in contrast to Frith's individualist model based on TOM, represents an interpersonal interpretation for the symptoms of schizophrenia, with a full consideration of the emotional variables of any inter-subjective transaction. This interpretation is consistent with literature highlighting the role of the negative emotions in the persistence of the symptoms of schizophrenia (Falloon & Marshall, 1983; Kemali, May, Ariano, Arena & Lovero, 1985; for a review see Costello, 1993).

Conclusions

We have hypothesised that negative symptoms in schizophrenia may arise from impoverished goal-oriented action together with a chronic disadherence to inter-subjective meanings. We argue that this may stem from a dysfunction in neural simulation processes. Disadherence, as we view it, depends on the fact that the patient can understand others' behaviour in terms of mental states but cannot pre-reflectively "choose" among the many possible hypotheses about others' mental state and communicated meanings; the one which would provide the quickest assistance in understanding the meaning of a current transaction. Disadherence may, therefore, be a direct cause of social withdrawal, an indirect cause of social disability, and result in impoverished goal-oriented action.

In our treatise, we have considered the importance of subjective experience, arousal and interpersonal behaviour in relation to psychopathological dimensions such as social withdrawal and social disability. Put another way, in our opinion, the changeable conditions of the inter-subjective context may play a major role in generating negative symptoms in schizophrenia.

Our work has many limitations and should be considered as a beginning. In the first place, we began with the salient experiences of a single client. The analysis of single cases

has been traditionally used in personality psychology (Borsboom, Mellenbergh & van Heerden, 2003), psychotherapy (Stiles, 1993, 2003) and neurosciences (see Damasio, 1994; Klein, Rozendal & Cosmides, 2002) for formulating or corroborating theory. Single case research also offers uniquely detailed and complex data that are inevitably more nuanced than that which can be gleaned from the analysis of a great number of subjects (Elliott, Fischer & Renne, 1999; Mays & Pope, 2000; Stiles, 1993, 2003). Nevertheless, more work is necessary, including further analyses**,** accompanied by neuroimaging studies, of more cases of schizophrenia with other forms of negative symptoms and social dysfunction. Particularly, the relation between impoverished goal-oriented action (and poor speech) and negative symptoms such as anhedonia awaits more systematic investigation through a series of single-case qualitative studies such as that of Alberto, but based upon a large number of audio-taped psychotherapy sessions.

A second limitation of our work is that the concept of disadherence to context requires further elaboration and its link with emotional variables needs to be clarified in a more systematic way. Additionally, it is unclear how this may be related to positive symptoms, which clearly can contribute to social dysfunction. In future studies, we plan to explore the delusional experiences of passivity, included in Schneider's first rank symptoms (1959), and formal thought disorder, as well as morbidly extreme levels of self-preoccupation. We also will seek to elaborate on how these processes may be exacerbated by social and psychological factors including stigma and low self esteem and what implications these may have for the process of psychotherapy.

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Figure 1. The cortical action control network hypothesised by Gallese, as the basis of the *shared manifold of inter-subjectivity*.