

Understanding Minds and Understanding Communicated Meanings in Schizophrenia

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Abstract: The work reported in this paper investigated the putative functional dependence of pragmatic language skills on general mind-reading capacity by testing theory-of-mind abilities and understanding of non-literal speech in patients with schizophrenia and in healthy controls. Patients showed difficulties with inferring mental states on a false-belief picture-sequencing task and with understanding metaphors and irony on a story-comprehension task. These difficulties were independent of low verbal IQ and a more generalised problem inhibiting prepotent information. Understanding of metaphors and understanding of irony made significant and *independent* contributions to discriminating patients from controls, suggesting that metaphor and irony make distinct pragmatic demands.

Cognitive neuropsychology is that branch of cognitive psychology that investigates people with acquired or developmental disorders of cognition. The aim is to learn more about how cognitive systems normally operate or about how they are normally acquired by studying selective patterns of cognitive breakdown after brain damage or selective difficulties in acquiring particular cognitive abilities. In the early days of modern cognitive neuropsychology, research focused on rather basic cognitive abilities such as speech comprehension or production at the single-word level, reading and spelling, object and face recognition, and short-term memory. More recently the cognitive-neuropsychological approach has been applied to the study of rather more complex domains of cognition such as belief fixation (e.g. Coltheart and Davies, 2000; Langdon and Coltheart, 2000) and pragmatic aspects of communication (e.g. McDonald and Van Sommers, 1993). Our paper concerns the investigation of pragmatic disorders in one clinical group in which such disorders are common, patients with schizophrenia, and what the study of such people can tell us about the normal processes of communication.

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1. Introduction: Pragmatics, Metaphor and Irony

Pragmatics is the study of how language is used and, in particular, how utterances are interpreted. It is part of the theory of performance, the use of linguistic knowledge, rather than part of the theory of linguistic knowledge itself (competence). If linguistic knowledge were the only kind of knowledge implicated in language use then interpreting an utterance would be a matter of decoding—using linguistic rules to work back from phonetic form to literal linguistic meaning—and the theory of performance would be concerned primarily with this decoding process. But the communicative use of language also draws on non-linguistic knowledge ('real world' knowledge) and utterance interpretation involves not only decoding but also inference. Pragmatics is that part of the theory of performance that focuses on the way in which language users draw on non-linguistic knowledge or assumptions, and engage in inference, in order to perpetrate and interpret utterances that convey messages that are not exhausted by encoded literal linguistic meaning. Phenomena that fall within the domain of pragmatics thus include the assignment of reference to pronouns and indexical words, other aspects of context dependence and, more generally, the ways in which what is communicated can be more specific than what is literally encoded. They also include metaphor and irony and other ways in which the message that is communicated may be, not just more specific than, but actually quite different from, the meaning that is literally encoded.¹

Contemporary pragmatic theory begins with Grice (1975, 1978, 1989). He proposed a Cooperative Principle² and a set of nine more specific conversational maxims, such as 'Make your contribution as informative as is required', 'Do not say what you believe to be false', and 'Do not say that for which you lack adequate evidence'. He suggested that observance of these by the participants in a communicative exchange is not so much a 'quasi-contractual matter' as something that can reasonably be assumed.³ Grice was concerned with the phenomenon of conversational implicature, in which what is communicated or implied is very different from what is literally said.⁴ He explained the generation of conversational implicatures in terms of the thoughts that a hearer must take a speaker to have in order to sustain the assumption that the speaker is indeed observing the conversational maxims 'or at least the Cooperative Principle' (1989, p. 31).

¹ Because pragmatics is concerned with the inferential use of non-linguistic knowledge in communication, its domain is naturally taken to include the communicative use of non-linguistic forms such as gestures or mime.

² Grice, 1989, p. 26: 'Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.'

³ *Ibid.*, pp. 26–31.

⁴ *Ibid.*, p. 33: 'A is writing a testimonial about a pupil who is a candidate for a philosophy job, and his letter reads as follows: "Dear Sir, Mr. X's command of English is excellent, and his attendance at tutorials has been regular. Yours, etc."'

Grice's theory of conversational implicature faces a number of serious problems; here we mention just one. The account of the generation of conversational implicatures is underspecified.⁵ We can see this by considering briefly what Grice says about metaphor and irony (*ibid.*, p. 34). In each case (metaphor: 'You are the cream in my coffee'; irony: 'X is a fine friend'), what is literally said is something that the speaker believes to be false. So, on the face of it, the speaker is flouting one of the maxims and a hearer must find some proposition, *q*, such that, by supposing the speaker to believe that *q*, the hearer can sustain the assumption that the speaker is observing the Cooperative Principle. Grice offers a gloss in each case (*ibid.*). For metaphor:

The most likely supposition is that the speaker is attributing to his audience some feature or features in respect of which the audience resembles (more or less fancifully) the mentioned substance.

And for irony:

[U]nless A's utterance is entirely pointless, A must be trying to get across some other proposition than the one he purports to be putting forward. This must be some obviously related proposition; the most obviously related proposition is the contradictory of the one he purports to be putting forward.

But Grice provides no explanation of the way in which the particular relationship between literal meaning and communicated message is to be worked out in each case.

The major development in post-Gricean pragmatics is Sperber and Wilson's Relevance Theory in which a single principle takes over the work that is done by the Cooperative Principle and the various maxims in Grice's theory.⁶ This is the Communicative Principle of Relevance: 'Every act of ostensive communication communicates the presumption of its own optimal relevance.'⁷

Relevance itself is defined in terms of cognitive effects and processing effort.⁸ In order to explain the notion of a cognitive effect, we need to make

⁵ Another problem is that the theory provides no account of how the various maxims are to be weighted against each other.

⁶ Thus Sperber and Wilson avoid the problem of having to weight maxims against each other.

⁷ Sperber and Wilson, 1995, p. 158 and pp. 260–1. The Communicative Principle of Relevance is not a rule by which communicators need to be guided. It is, rather, a descriptive claim (1995, p. 162): 'Communicators and audience need no more know the principle of relevance to communicate than they need to know the principles of genetics to reproduce. . . . It is not the general principle, but the fact that a particular presumption of relevance has been communicated by and about a particular act of communication, that the audience uses in inferential comprehension.'

⁸ See Sperber and Wilson, 1995, Chapter 3 and Postface.

use of the idea of a context: a set of assumptions that are in the forefront of a hearer's attention. If a hearer is presented with some new information then this may interact with the assumptions in the hearer's context. It may be, for example, that some implication can be drawn from the new information when it is put together with some of the assumptions in the context; this is a contextual implication, the simplest example of a cognitive effect. Relevance increases as cognitive effects increase and decreases as the processing effort needed to derive those cognitive effects increases. So the Communicative Principle of Relevance says, roughly, that when a speaker claims the attention of a hearer by uttering an utterance this automatically communicates to the hearer that the cognitive effects that will result from processing the utterance will be worth the effort expended.⁹

Relevance theory avoids a number of the problems that are faced by Grice's theory of conversational implicature. In particular, Sperber and Wilson give detailed and substantive accounts of metaphor and irony. We shall not rehearse all the details here; but it is important, at the outset, to note a similarity between the two phenomena and also a difference. The similarity is that both metaphor and irony are said to involve the use of 'very general mechanisms of verbal communication'; the relevance-theory accounts of metaphor and irony are continuous with accounts of utterances that are neither metaphorical nor ironical.¹⁰ The difference is that metaphor is a kind of loose talk, and so a *descriptive* use of language, while irony is an echoic,¹¹ and so an *interpretive*, use of language.

Interpretation, as the notion is used here, is a matter of resemblance between representations. In general, any utterance is an interpretation or an *interpretive expression* of the thought that the speaker wants to communicate. But the speaker's thought may itself be entertained either as a representation of how things actually are or else as a representation that resembles some other representation, such as a thought or utterance by another person. In the first case, the speaker's utterance is a descriptive use of language because it is an interpretive expression of a thought that is itself entertained as a description of how things are. In the second case, the speaker's utterance is an interpretive use of language because it is an interpretive expression of a thought that is itself entertained as an interpretation of some other thought or utterance.

⁹ Sperber and Wilson, 1986b, p. 588: 'If humans pay attention only to relevant information, a communicator, by claiming an audience's attention, gives a guarantee of relevance. He guarantees, in particular, that the information he is attempting to convey, when processed in a context he believes the audience has accessible, will be relevant enough to be worth the audience's attention.' See Sperber and Wilson, 1995, pp. 266–71, for further discussion of the presumption of optimal relevance.

¹⁰ Sperber and Wilson, 1995, p. 238: 'If we are right, then the same is true of irony as is true of metaphor: whatever abilities and procedures are needed to understand it are independently needed for the interpretation of quite ordinary non-figurative utterances.'

¹¹ See also Kreuz and Glucksberg, 1989.

The utterance of a sentence that is strictly speaking false may be a highly effective way of communicating a whole set of propositions that can be easily derived as logical or contextual implications from the initial piece of (mis-)information. This is loose talk.¹² The full set of logical and contextual implications of the literally false proposition resembles, but is certainly not the same as, the set of thoughts that the speaker holds true and aims to communicate. Loose talk works because hearers are able to use the presumption of optimal relevance to select some implications and ignore others. In recent discussions of loose talk, Sperber and Wilson add to this account the proposal that the hearer works back from the selected implications to construct *ad hoc* concepts.¹³ These concepts, which may well not be literally encoded by any words or phrases of the language being used, can then figure as constituents in a proposition that the hearer takes as the speaker's explicitly communicated meaning. The words actually used may be said to *indicate* these *ad hoc* concepts, in line with the general idea that the meaning that is linguistically encoded in an utterance provides only an indication or outline of the speaker's meaning.

According to relevance theory, metaphor is a kind of loose talk. The perpetrator of a metaphor uses an utterance of a sentence that is literally false (such as 'Robert is a bulldozer'). The speaker's intention is that the hearer should derive a set of contextual implications and should construct an *ad hoc* concept that shares some, but not all, of the logical and encyclopaedic properties of the concept that is linguistically encoded (here, by the word 'bulldozer').¹⁴

Metaphor is a descriptive use of language. The speaker's thought, interpretively expressed in a literally false utterance, is entertained as a description of how things are in the world. But sometimes a speaker may think about the thoughts of another person. The speaker may entertain a thought, not as a description of how things are in the world, but rather as an interpretation of the other person's thought. That is, the speaker's thought may be entertained as resembling the thought of the other person. In such a case there is a two-step relation of resemblance or interpretation between the speaker's utterance and the thought of this other person and the utterance constitutes an interpretive use of language.¹⁵ Utterances that are two-step interpretations of the thoughts of another person may serve to inform the hearer of the speaker's attitude towards the thoughts of that other person (who may indeed be the hearer).

Sperber and Wilson offer a range of examples in which an utterance echoes

¹² For an early relevance-theory account, see Sperber and Wilson, 1986a.

¹³ Wilson and Sperber, forthcoming; see also Sperber and Wilson, 1998.

¹⁴ Notions similar to that of an *ad hoc* concept also figure in the accounts of metaphor interpretation proposed by Glucksberg, 1995, 1998 and Kintsch, 2000.

¹⁵ Sperber and Wilson, 1995, p. 238, describe these cases as 'second-degree interpretations'.

the words of another person and is used to convey an attitude towards that other person's thought. Here is one (1995, p. 239):

He: It's a lovely day for a picnic.
[They go for a picnic and the sun shines.]
She (happily): It's a lovely day for a picnic, indeed.

It is a very short step from here to irony (*ibid.*):

He: It's a lovely day for a picnic.
[They go for a picnic and it rains.]
She (sarcastically): It's a lovely day for a picnic, indeed.

According to relevance theory, irony is a kind of echoic use of language (*ibid.*): 'The speaker dissociates herself from the opinion echoed and indicates that she does not hold it herself.' In general, the interpretation of an utterance as ironical involves the recognition of the utterance as echoic, the identification of the person or kind of person whose thought is being echoed, and the recognition that the speaker's attitude towards this thought is one of rejection or dissociation (1995, p. 240).

Sperber and Wilson stress the point that all normal linguistic communication involves not only decoding of literal linguistic meaning but also inference. Inferential processes are needed to fill in the literal outline or template by assigning reference to pronouns, making the communicated message more specific, elaborating the communicated message by drawing out contextual implications, and constructing *ad hoc* concepts. In fact, inference occurs twice over in the relevance-theory account of utterance interpretation. First, the generation of cognitive effects, such as contextual implications, involves deductive inference.¹⁶ But second, and more generally, understanding an utterance is a matter of inductive or abductive inference to a hypothesis about the thought in the mind of the speaker and about the speaker's intentions. In a typical case of understanding a descriptive use of language, the hypothesis is that the speaker has a particular thought, that this thought is entertained as a description of how things are in the world, and that the speaker's intention is to convey information about the world. In a typical case of understanding an interpretive use of language, the hypothesis is that the speaker has a particular thought, that this thought is entertained as resembling the thought or utterance of another person, and that the speaker's intention is to convey an attitude towards this other person's thought or utterance.

A hearer who understands a descriptive use of language assumes that the speaker has a mind and is capable of entertaining thoughts about the world. A

¹⁶ See Sperber and Wilson, 1995, chapter 2.

hearer who understands an interpretive use of language makes a more complex assumption about the speaker: the speaker is capable of entertaining thoughts about, and adopting attitudes towards, the thoughts of other people. Understanding a descriptive use of language involves an inference to the speaker's thoughts about the world; understanding an interpretive use of language involves an inference to the speaker's thoughts about thoughts. So, in this respect, understanding irony is more demanding than understanding metaphor.

But there is also a respect in which understanding metaphor is more demanding. Understanding a metaphorical utterance (such as 'Robert is a bulldozer') involves selecting some logical and contextual implications and ignoring others; it involves constructing an *ad hoc* concept that shares some, but not all, of the logical and encyclopaedic properties of the concept that is linguistically encoded. It is true that these processes of selection and construction are also implicated in understanding non-metaphorical utterances and may well be involved in understanding an utterance that is intended ironically. But there are differences of degree here, ranging from routine cases of loose talk ('Holland is flat'), through well-worn but not quite dead metaphors ('This room is a pigsty'), to creative metaphors ('His ink is pale').¹⁷ So in respect of the processes of selection of implications and construction of *ad hoc* concepts, understanding a metaphorical utterance is more demanding than understanding an ironical (and non-metaphorical) utterance.

2. Pragmatics and Theory of Mind

The ability to attribute mental states to people in order to explain and predict their thoughts and behaviour is a cornerstone of everyday social interactions, including communication. The possession of a 'theory of mind' is sometimes referred to as the capacity to *mentalise* (Frith, Morton and Leslie, 1991) or to *mind-read* (Baron-Cohen, 1995). Sperber and Wilson's (1995) approach to pragmatics highlights the role that mind-reading ability plays in normal communication, for all utterance interpretation involves an inference to a hypothesis about the speaker's intentions. This is why it is illuminating to investigate communication in people with a theory-of-mind impairment.

Traditionally, the key indicator of an intact ability to attribute mental states has been a demonstrated understanding that people can act on the basis of beliefs that misrepresent the true state of affairs (Dennett, 1978; Pylyshyn, 1978). To this day, prototypical tests of this general capacity to read minds, historically termed *theory-of-mind tasks*, require subjects to predict or explain another person's behaviour by attributing mental states to the person in circumstances where the contents of the person's mental state cannot be derived directly from the objective facts of a situation. For example, in a *false belief*

¹⁷ See Sperber and Wilson, 1995, pp. 231–7; Wilson and Sperber, forthcoming.

variant of a theory-of-mind task a subject must predict that another person can act on the basis of a belief, which the subject knows to misrepresent the true state of affairs. In a *deception* variant of a theory-of-mind task, a subject must, in order to gain some strategic advantage, manipulate an opponent into forming a belief, which the subject knows to misrepresent the true state of affairs.

From relevance theory, it follows that tasks that test understanding of utterances must also tap general mind-reading capacity.¹⁸ For individuals who are impaired in their general ability to read minds should also be impaired in their ability to infer speakers' communicative intentions. Autistic individuals are known to demonstrate a general insensitivity to other people's minds on theory-of-mind tasks testing understanding of false beliefs, deception, the effects of limited knowledge, changing mental states, and appearance-reality distinctions.¹⁹ So it is consistent with relevance theory that autistic individuals have also been found to demonstrate a poor understanding of speakers' intended meanings whenever speakers use metaphorical speech and ironical speech²⁰ and a difficulty with distinguishing the different intentions of speakers who make jokes and speakers who lie.²¹

2.1 Acquired Impairments of Pragmatics and of Theory of Mind

The findings from autism research are compelling in their own right and generally consistent with Sperber and Wilson's position. But they are of limited usefulness for assessing the nature of the relationship between normal mind-reading and normal pragmatics. Evidence of a link between poor mind-reading and poor pragmatics in an early-onset neurodevelopmental disorder such as autism may potentially say more about the role that normal mind-reading ability plays in the *acquisition* of a normal understanding of pragmatic uses of language than it does about the role that normal mind-reading ability plays in the *on-line* processes that underpin pragmatic uses of language in developed adults.²² So the proposal that everyday communication depends fundamentally on the on-line use of an ability to read minds would be strengthened considerably by evidence that there are forms of acquired cognitive dysfunction that can occur later in life and which are such that, if they impair the functional capacity of a mind to read other minds, then they also impair the functional

¹⁸ See Sperber, 2000; Wilson, 2000.

¹⁹ Baron-Cohen, 1989a, 1989b, 1991; Baron-Cohen *et al.*, 1985; Leslie and Frith, 1988; Perner *et al.*, 1989; Sodian and Frith, 1992.

²⁰ Happé, 1991, 1993, 1995; Tantam, 1991.

²¹ Leekam and Prior, 1994.

²² For a general discussion of the importance of the distinction between distal and proximal causes for developmental cognitive neuropsychology, see Jackson and Coltheart, 2001, Chapter 2, 'Proximal and distal causes of individual differences in reading'.

capacity of a mind to use and understand language pragmatically. In short, it is important to find out whether the link between poor mind-reading and poor pragmatics that holds for autism also holds for an acquired neurological disorder, such as that following stroke damage, or a late-onset neurodevelopmental/neurodegenerative disorder, such as schizophrenia.

In fact, there is accumulating evidence of poor theory-of-mind task performance in individuals with acquired disorders of pragmatics, just as in autistic individuals with developmental disorders of pragmatics. So the case has become much stronger that a spontaneous ability to take account of other people's thoughts makes a fundamental on-line contribution to the ability to express and interpret intended meanings in normal communication. For example, patients who have sustained right hemisphere brain damage and who are known to be poor pragmatic communicators (see Happé, Brownell and Winner, 1999, for a review) have also been found to demonstrate general mind-reading impairments on story and cartoon versions of theory-of-mind tasks.²³ Furthermore, it is not only right hemisphere brain damage that can cause deficits of mind-reading and deficits of pragmatics later in life; frontal lobe brain damage also brings on these problems. For example, it has been known for many years that patients with frontal lesions exhibit pervasive pragmatics deficits including (a) difficulty with formulating hints (McDonald and Van Sommers, 1993), (b) impaired ability to provide adequate information (e.g. when explaining a board game to a novice; McDonald and Pearce, 1995), (c) failure to take account of a listener's interest when conversing (Kaczmarek, 1984), and (d) literal misinterpretations of sarcastic utterances (McDonald and Pearce, 1996). More recently it has been found that patients with frontal lesions also demonstrate general mind-reading deficits on story and cartoon versions of traditional theory-of-mind tasks²⁴ and on a less traditional perspective-taking test of general mind-reading ability.²⁵

Finally, there is evidence from within the psychiatric literature that individuals who become poor pragmatic communicators later in their life due to some form of late-onset neuropathology also turn out to be poor mind-readers. The primary example here, coming from a long history of research into psychotic thought disorder, is schizophrenia.

2.2 Schizophrenia, Pragmatics and Theory of Mind

Schizophrenia is considered to be the most severe of the psychotic disorders²⁶ and has an onset that is typically in late adolescence or early adulthood.

²³ Happé *et al.*, 1999; Siegal, Carrington and Radel, 1996; Winner *et al.*, 1998.

²⁴ Happé, Malhi and Checkley, 2000; Bach *et al.*, 1998, 2000; Stone, Baron-Cohen and Knight, 1998.

²⁵ Price *et al.*, 1990.

²⁶ The term *psychosis* derives originally from 'psyche' meaning 'the mind' and 'osis' meaning 'illness of', hence 'illness of the mind'—a very vague concept. Over the years, the term has been used in a number of different ways—for example, at one point, to distinguish disorders

According to the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, 1994)*, the characteristic symptoms of schizophrenia are delusions, hallucinations, disorganised speech, grossly disorganised behaviour, and negative symptoms. The latter include lack of emotional responsiveness, *alogia* (i.e. a poverty in the amount of speech or in the content of speech), *apathy*, and *anhedonia* (i.e. a loss of joy in life).

Disturbances of communication have been considered hallmark features of schizophrenia since the time that Bleuler (1911/1950) and Kraepelin (1919/1971) first identified the disorder. The communicative abnormalities observed in patients with schizophrenia have been categorised traditionally as aberrations of *content* (delusions and hallucinations) and aberrations of *form* (abnormal ways of organising and expressing ideas, even when those ideas have normal content). It is the latter that interest us here. Psychiatrists refer to these abnormalities of thought form as 'formal thought disorder'.

Some of the most common features of the so-called 'formal thought disorder' in schizophrenia are tangentiality, derailment, incoherence, loss of the chain of thought, and self-referentiality. Table 1 contains examples (taken from Frith, 1992). Our view is that it is reasonable to treat some of these as demonstrating pragmatic impairments in *expressive* communication.

Patients with schizophrenia also demonstrate pervasive pragmatic impairments in *comprehension*. It has been known at least since the early 1940s (see Kasanin, 1944, for a review) that patients with schizophrenia have severe difficulties when asked to interpret metaphors and proverbs—indeed a patient's poor performance on the Gorham Proverbs Test was once considered a useful diagnostic marker of schizophrenia.²⁷ From that time to the present day, researchers have continued to document impaired interpretation of non-literal utterances in patients with schizophrenia, including, for example, (a) a preference for literal rather than figurative interpretations of metaphors (Chapman, 1960; Cutting and Murphy, 1990; Drury, Robinson and Birchwood, 1998), (b) difficulty with selecting appropriate pictures to match figurative meanings of metaphors (Anand *et al.*, 1994), (c) impaired ability to match metaphors and proverbs that are similar in meaning at a figurative level (de Bonis *et al.*, 1997), (d) difficulty with selecting appropriate metaphors to complete meaningful sentences (Drury *et al.*, 1998), and (e) absence of semantic priming for targets that are metaphorically rather than literally related to the prime (Spitzer, 1997).²⁸

of the brain (psychoses) from nervous conditions (neuroses). Today, the term is generally taken to apply to conditions where a patient adopts an alternate reality, defined by the presence of delusions and/or hallucinations, although bizarre and idiosyncratic patterns of behaviour and speech are also considered features of acute psychotic states.

²⁷ See Gorham, 1956; also see Andreasen, 1977, for an evaluation of the usefulness of proverb interpretation for assessing mental status.

²⁸ A word is recognised faster if preceded by a meaningfully related word. Thus, for example, in a lexical decision task, where a subject must judge whether a letter string is a real word or not, response times (RTs) for 'black' are faster when 'black' is preceded by 'white' rather

Table 1 Examples of disturbed communication found in patients with schizophrenia

Tangentiality	Question: 'What city are you from?' Answer: '...I was born in Iowa, but I know that I'm white instead of black so apparently I came from the north somewhere and I don't know where, you know, I really don't know where my ancestors came from ...'	Andreasen (1979)
Derailment	Question: 'How are things at home?' Answer: 'What I'm saying is my mother is too ill. No money. It all comes out of her pocket. My flat's leaking. It's ruined my mattress. It's Lambeth council. I'd like to know what the caption in the motto under their coat of arms is. It's in Latin ...'	Cutting (1985)
Self-reference	Question: 'What time is it?' Answer: 'Seven o'clock. That's my problem. I never know what time it is. Maybe I should try to keep better track of the time.'	Andreasen (1979)

More recently, researchers have gone beyond the traditional focus on metaphors and proverbs to establish that patients with schizophrenia also have difficulties when required to infer intended meanings of indirect hints (Corcoran, Mercer and Frith, 1995), when required to interpret ironical utterances (Mitchley *et al.*, 1998), and when required to use conversational cues that would normally prompt a need to be politely circumspect in the circumstances (Corcoran and Frith, 1996).

It has become increasingly apparent in recent years not only that some patients with schizophrenia exhibit late-onset impairments of pragmatics but also that some exhibit late-onset impairments of general mind-reading. For example, these individuals show (a) poor understanding of false beliefs and deception on story-comprehension tasks (Doody *et al.*, 1998; Drury *et al.*, 1998; Frith and Corcoran, 1996), (b) a lack of appreciation of visual jokes when understanding the humour depends upon inferred mental states but not

than by 'soft', an unrelated word. This is the *semantic priming effect*. In the study mentioned in the text, Spitzer found that healthy controls showed a semantic priming effect for both the concretely related 'snow' and the metaphorically related 'risk' when these followed the utterance 'He is skating on thin ice'; whereas patients with schizophrenia only showed a semantic priming effect for 'snow'.

when understanding the humour depends upon non-mentalistic inferences²⁹ (Corcoran, Cahill and Frith, 1997), (c) difficulty with inferring appropriate intentions in comic-strip characters (Sarfati *et al.*, 1997, 1999a, 1999b), (d) impaired ability to infer complex mental states such as being thoughtful or bored from other people's expressions (Kington *et al.*, 2000), and (e) poor sequencing of picture-card stories that require inferences of false beliefs in story characters in order to determine the logical order of events (Langdon *et al.*, 1997, 2001).

The main aim of the work we report here was to build on this well-established literature by investigating the co-occurrences of theory-of-mind deficits and pragmatic deficits in patients with schizophrenia in order to examine the putative functional dependence of comprehension of non-literal speech on general mind-reading ability. Many of the developmental, neuropsychological and psychiatric studies cited earlier have only investigated theory-of-mind deficits and pragmatics deficits in separate groups of individuals. Few studies have directly investigated the co-occurrence of theory-of-mind deficits and pragmatics deficits, or explored in any depth the patterns of interrelationships between poor mind-reading and poor pragmatics in the same groups of individuals. The most notable exceptions here are the work of Winner *et al.* (1998) and Happé (1993). Winner and her colleagues provided evidence that ability to attribute second-order beliefs³⁰ is a significant predictor of ability to distinguish the different intentions behind jokes and behind lies in right hemisphere brain damaged patients—and in normal controls for that matter. Happé provided evidence that understanding of metaphors requires only an intact first-order mind-reading ability in autistic individuals, whereas understanding of irony requires an intact second-order mind-reading ability in these individuals.

But before discussing possible predictions about the nature of the relationship between poor mind-reading and poor comprehension of different types of non-literal speech in patients with schizophrenia, we need to consider the relationship between frontal-lobe neuropathology, poor mind-reading and poor pragmatics. This is especially important, since frontal neuropathology is known to be a feature of schizophrenia (Andreasen *et al.*, 1992; Pantelis *et al.*, 1997).

²⁹ It should be noted here that these non-mentalistic inferences are far from simple—for example, in one of the cartoons used by Corcoran and colleagues, subjects are asked to explain what is funny about seeing a parachutist falling to earth (with a parachute) beside a panda bear (also falling to earth but without a parachute) who is saying to the parachutist, 'It's no wonder we're an endangered species, really.'

³⁰ First-order theory-of-mind tasks test a subject's ability to infer another person's thoughts or beliefs about the state of the world; second-order theory-of-mind tasks test the ability of a subject to infer one person's thoughts (or beliefs) about the contents of another person's thoughts about the state of the world.

2.3 The Role of Frontal Lobe Pathology in Poor Mind-reading and in Poor Pragmatics

In everyday life, patients with frontal lesions exhibit a plethora of social and planning deficits, including social disinhibition, utilisation behaviour,³¹ apathy, lack of emotional responsiveness, distractibility, poor planning and difficulty in handling novel situations. In experimental studies, patients with frontal lesions also demonstrate poor mind-reading and poor pragmatics. Normal functioning of the frontal lobes is deemed critical for a number of 'executive' capacities, including strategic uses of memory, selective focusing of attention, strategic planning for the future, multi-tasking/scheduling, and inhibitory control (this being the capacity to suppress 'prepotent' response tendencies). Might it not be, then, that patients with structural and/or functional damage to frontal regions (including some patients with schizophrenia) show poor mind-reading and poor pragmatics because theory-of-mind tasks and tasks testing the comprehension of non-literal speech both tap, at some more fundamental level, a common executive capacity sustained by intact frontal neurophysiology?

It is not possible within the scope of this paper to review the lengthy and on-going debate about the nature of the relationship between executive functions and theory-of-mind abilities.³² In brief, once it had been discovered that executive capacities and theory-of-mind abilities develop at around the same age in young children and that theory-of-mind deficits co-occur with executive deficits in autistic individuals, debate began concerning whether or not these co-occurrences (often statistically predictive of each other) reflect some form of functional dependence or are, instead, an accident of neuroanatomy due to the neuroanatomical proximity of neural substrates that underpin two capacities which are functionally independent.

This debate continues. Those who believe that executive capacity and theory-of-mind ability are in some way functionally dependent consider it most likely that an intact executive capacity to suppress prepotent response tendencies is a necessary (if possibly not sufficient) condition for success on theory-of-mind tasks. The general idea here is that subjects may be performing poorly on theory-of-mind tasks, not because they do not know about mental states, but because they act as if functionally mind-blind in the context of the task. They are captured by, and they fail to inhibit, the cognitively salient but inappropriate information that is typically featured in these tasks—e.g. the critical target object in false belief and deception tasks.³³

³¹ For example, reaching for a nearby pair of scissors and making cutting actions even though such behaviour is completely uncalled-for in the circumstances.

³² See Perner and Lang, 1999, for discussion.

³³ See, for example, Russell, Saltmarsh and Hill, 1999. We acknowledge here that this view predicts that individuals who have an impaired capacity to suppress prepotent information should not be capable of succeeding on theory-of-mind tasks; and, counter to that view, there is some evidence to suggest that individuals with impaired executive capacities can perform normally on mind-reading tasks. However at this point the number of findings to

Suppose that we entertain, at least for the moment, the possibility that an intact executive capacity to suppress prepotent response tendencies is a necessary pre-condition for normal mind-reading, particularly when the objective facts of a situation run counter to the thoughts being inferred. We might then ask: Is this capacity for inhibitory suppression also necessary for a normal ability to infer speakers' communicative intentions, particularly when intended meanings are discordant with literal meanings, as they are in metaphorical speech and in ironical speech? That is another question that has prompted much debate—again too much debate for it to be comprehensively reviewed in this paper.

In brief, inhibitory suppression has been conceptualised primarily in terms of a stage model where the literal meaning of a figurative utterance needs to be computed as the first obligatory step and then rejected (*suppressed*) as being inadequate in the conversational context, before any further inferences can come into play. When the dominant view shifted away from stage models of this type towards the idea that listeners engage in a *direct* search for relevance, there was a corresponding shift away from the idea that inhibitory suppression has an important part to play in the comprehension of non-literal speech. However proposing a direct search model does not entail abandoning the idea that inhibitory suppression (driven by feedback from conversational context) has a critical part to play in the *direct* computation of relevant meaning. For example, Kintsch (2000) has developed a computational model of utterance comprehension where, for example, in the case of the metaphor 'my lawyer is a shark' (p. 258): 'the argument selects those features of the (metaphoric) predicate that are appropriate for it and inhibits the features that do not apply or apply less aptly.'

Advocates of a direct search model would want a computational model of utterance comprehension that was capable of outputting different interpretations of the same utterance in different contexts (the literal concrete interpretation in one context and the figurative interpretation in another context). It is difficult to see how one could provide such a model without building into it the capacity to enhance some logical and encyclopaedic features of the concepts that are linguistically encoded, if these features are relevant, and to inhibit other logical and encyclopaedic features that are irrelevant in the context.

Computational modelling aside, there are purely empirical grounds for thinking that inhibitory suppression (mediated by the frontal lobes) does have a role to play in the comprehension of non-literal speech. For example, McDonald and Pearce (1996) have found that an impaired ability to inhibit a salient response in order to 'shift set' (indexed by poor performances on the

that effect is small and, in all cases thus far, small numbers have been involved, prompting some concerns about how one should set the dividing line between normal and abnormal in these circumstances. See Perner and Lang, 1999, for discussion.

Wisconsin Card Sort test³⁴) predicts literal misinterpretations of sarcastic utterances in patients with frontal lobe damage.³⁵

2.4 Predictions about Mind-reading, Metaphor and Irony

The work reported here used a picture-sequencing task that is explained in detail later (see below, Section 3.2.1). This test of general mind-reading ability has been used elsewhere to demonstrate that impairments of inhibitory suppression, although found in general samples of patients with schizophrenia, cannot adequately explain all cases of poor mind-reading in these individuals (Langdon *et al.*, 2001). The question of interest for the present paper concerns the comprehension of speakers' intended meanings in cases where a literal decoding of the words used in an utterance will not suffice. Does the domain-specific form of mind-reading impairment that is found in some patients with schizophrenia cause these individuals also to have difficulties with pragmatic interpretation?

On Grice's account, both metaphor and irony are cases in which the maxim, 'Do not say what you believe to be false', has been violated and the hearer must recognise a conversational implicature by assuming that the speaker is nevertheless observing the Cooperative Principle.³⁶ The relationship between the literal meaning of the sentence uttered and the communicated message is different in the two cases. But there is nothing in Grice's account to suggest that the comprehension of metaphor and of irony involve substantially different processes. So, the apparent prediction from Grice's account would be that, if patients with schizophrenia have a selective difficulty with inferring the contents of another person's mind, then such patients will show both an impaired understanding of metaphorical speech and an impaired understanding of ironical speech.

On Sperber and Wilson's (1995) account, in contrast, there is an important

³⁴ In the Wisconsin Card Sort test, subjects are presented with cards that can be sorted on a number of dimensions (e.g. shape of objects, number of objects, colour of objects). Cards are presented to subjects one at a time and the subjects are asked to sort the cards according to some rule, a rule that is unknown to the subjects but which they attempt to infer on the basis of correct/incorrect feedback after moving a card to a particular pile. At some point, after subjects have correctly inferred the first rule, the rule is changed without warning. Subjects must then stop perseverating on the dimension that was relevant for the old rule in order to infer the new rule.

³⁵ In this sub-section, we have suggested that inhibitory suppression is likely to be necessary both for the interpretation of metaphorical utterances and for the interpretation of ironical utterances. At the end of section 1, we said that there is a respect in which metaphor is more demanding than irony. We are not suggesting here that metaphor interpretation depends more heavily on inhibitory suppression than irony interpretation does. According to our discussion in section 1, there are processes—specifically, processes implicated in the construction of *ad hoc* concepts—that go beyond inhibitory suppression and are more involved in metaphor interpretation than in irony interpretation. See below, section 4.3.

³⁶ See Nogales, 1999, for discussion.

difference between metaphor and irony. Metaphor is a descriptive use of language; irony is an interpretive use. Understanding an ironical utterance involves recognition of the utterance as echoic and then the identification of the person whose thought is being echoed and the recognition of the speaker's attitude towards this thought. So, according to relevance theory, there is a compelling reason for predicting that normal mind-reading ability is critical for normal understanding of ironical utterances. It is a hearer's on-line ability to go beyond the objective facts of a situation and to infer what is going on in someone else's mind that will allow a hearer to appreciate that a speaker is adopting an attitude of rejection or disapproval to an echoed thought. This attitude is not encoded by the words that are used; the literal meaning of the sentence that is uttered determines (at most) the content of the thought that is being echoed.

Because an ironical utterance achieves relevance by informing the hearer of the speaker's attitude towards a thought, understanding ironical speech requires a high degree of mentalising ability. The hearer must attribute to the speaker, not just a thought about the world, but a thought about a thought—a *second-order* mental state. For this reason, Happé predicted, in her research with autistic individuals (1993, 1995), that understanding irony would require second-order theory of mind ability.

Happé also predicted that interpreting similes, 'which can be understood at a purely literal level' (1993, p. 103), would be possible even for autistic individuals who lack a theory of mind altogether, while metaphor interpretation, since it 'requires some understanding of intentions' (*ibid.*, p. 104), would require first-order theory of mind ability.

So far as the interpretation of purely literal utterances are concerned, we note that Sperber and Wilson say (1995, p. 170):

The coded signal, even if it is unambiguous, is only a piece of evidence about the communicator's intentions, and has to be used inferentially in a context. The hypothesis the signal suggests still has to be tested for consistency with the principle of relevance, and if it fails to meet this criterion, it must be rejected.

So, although literal meaning can be decoded, inference is still needed if the hearer is to discern whether the speaker is, for example, committing herself to the truth of the literally meant proposition. So, while there is a sense in which a wholly literal utterance could, as Happé suggests, be understood by a hearer who totally lacked theory of mind abilities, there is also a sense in which the utterance, considered as a speech act, would not be fully understood.

So far as metaphor is concerned, we note that, while understanding metaphorical utterances surely requires some appreciation that the speaker is capable of having thoughts about the world, it is far from clear that it requires the kinds of abilities that are assessed by typical theory-of-mind tasks. There is an

important distinction between the basic ability to represent mental states—to construct the representation, ‘Sally believes that the marble is in the basket’, for example—and the ability to work out, from facts about Sally’s situation, whether it is likely to be true that Sally believes that the marble is in the basket.³⁷ We need to keep this distinction in mind as we work out our predictions about metaphor interpretation in people with schizophrenia.

On the one hand, total inability to represent people’s mental states would surely make it impossible for a hearer to recognise a communicative act as such, for it would not allow any hypotheses about a speaker’s intentions or beliefs even to be entertained. But schizophrenic patients who fail theory-of-mind tasks are not unable to represent people’s mental states. These individuals know that people have beliefs and intentions and they are perfectly capable of representing that other people can believe things that differ from what they themselves believe. Indeed, they are often very adept at concealing their own beliefs from other people. If anything, these individuals can sometimes over-attribute intentions. A paranoid schizophrenic patient who believes that other people are harbouring hostile or persecutory thoughts about him or her (common in schizophrenia) can hardly be thought of as someone with an *inability* to represent the mental states of others—the inability which is believed to characterise autism.

On the other hand, it is not clear that an impairment in working out what beliefs or intentions someone is likely to have, given the full facts about that person’s situation, would make metaphor interpretation difficult. It is true that the final upshot of an exercise of metaphor interpretation may be an attribution of a more or less specific intention, and a more or less specific set of beliefs, to the speaker. But it does not follow that the method by which this attribution is reached draws on the general abilities that fall under the term ‘theory of mind’. Perhaps a heard utterance directly cues, in the mind of the hearer who has a basic ability to represent mental states, an automatic interactive interrogation of a store of logical and encyclopaedic knowledge. Selected information from this knowledge base would then be used in order to derive cognitive effects until an optimal trade-off between cognitive effects and processing effort was achieved. It is true that a more general ability to mind-read in a contextually sensitive way would have to come into play if a hearer doubted the correctness of his initial interpretation and then went on to evaluate whether it could possibly match *what the speaker had in mind*. But that is a step well beyond the initial process of interpretation.³⁸ As Sperber says (2000, p. 133):

In all cases . . . the comprehension procedure is the same: follow the path of least effort until adequate relevance is achieved. This may yield a literal,

³⁷ See Bloom and German, 2000.

³⁸ See Wilson, 2000.

a loose, or a metaphorical interpretation without the comprehender having to take notice of the type of interpretation achieved.

The *conclusion* of such a process of interpretation is an attribution of a meaning to the speaker and, hence, a metarepresentation. Nevertheless, the *premises* in the inference process need not be metarepresentational. The procedure, therefore, can be followed by a relatively unsophisticated metarepresenter, for instance by a young child capable, as young children are, of comprehending metaphor.

We suggest that the more comprehensive ability to infer the likely contents of a person's thoughts from the full circumstances of that person's situation, as measured by most theory-of-mind tasks (certainly those used with adults), may not be a critical process in the interpretation of metaphorical speech by normal adults.³⁹

A recent single-case study of a 32 year-old man BM, with amygdala damage and past diagnoses of schizophrenia and Asperger's syndrome, provides some support for this view (Fine, Lumsden and Blair, 2000). BM showed a marked impairment in his ability to interpret sarcasm but was *completely normal* on a test of metaphor interpretation. He also showed pervasive mind-reading impairments in the absence of any executive dysfunction. For example, he was below normal when asked to interpret mental state stories (but not when asked to interpret physical stories) on two sets of stories based on Happé's (1994) Advanced Theory of Mind Test. He also showed a marked inability to appreciate the humour of mental state cartoons (but not the humour of physical cartoons) on two sets of visual jokes based on the Corcoran, Cahill and Frith (1997) study.

³⁹ There is certainly no explicit place in Glucksberg's (1995, 1998) theory of metaphor predication for the kind of mind-reading ability that is assessed by typical theory-of-mind tasks. According to Glucksberg, people understand a metaphor like 'crime is a disease' using a schema (1995, p. 48): 'the schema is used to attribute an organised set of properties to the metaphor topic by projecting onto a target domain, such as crime, all of the relevant properties of a source domain, such as disease'. On this view, a hearer needs to have the concepts of 'crime' and 'disease' and needs to be able to select those properties of disease that are relevant to the crime domain, in order to understand the metaphor, 'crime is a disease'. But (as Sperber says) the hearer does not need any very sophisticated mind-reading capacity in order to attribute the metaphorical meaning of 'crime is a disease' to the speaker (as a thought entertained as a description of how things are in the world). Nor does mind-reading figure explicitly in Kintsch's (2000) computational model of metaphor interpretation.

On these theories, there is no reason to think that poor mind-reading of a selective kind in patients with schizophrenia (i.e. poor performance on theory-of-mind tasks that cannot be explained by poor inhibitory suppression) will have anything at all to do with the poor understanding of metaphorical speech that is found in these individuals. In contrast, poor mind-reading of the type that reflects a general problem with inhibiting prepotent responses will necessarily cause poor comprehension of metaphorical speech in affected individuals, since such an impairment will disrupt the inhibitory feedback from context that prioritises a metaphorical interpretation if relevant in the context.

Although BM had a severe theory-of-mind impairment and was not very good at working out what beliefs someone was likely to have given the facts about that person's situation, it is not plausible that BM was totally incapable of representing mental states. BM did not perform at 100% failure rates on all the theory-of-mind tasks that he was given. For example, he passed the Smarties test,⁴⁰ and he clearly understood what was meant when, having just seen that the Smarties box contained pencils, he was asked what another person would *think* was in the box.⁴¹ We suggest that an intact basic ability to represent the mental states of other people and an impaired ability to engage in more sophisticated mind-reading may together explain why BM can understand descriptive utterances, whether literal or metaphorical, but not ironical utterances.

According to relevance theory, normal mind-reading ability (including the more complex ability to attribute second-order mental states) underpins normal understanding of ironical utterances. Hence, a selective difficulty, in some patients with schizophrenia, with inferring what is going on in the mind of someone else should predict impaired understanding of ironical utterances in these same individuals. But it does not follow from relevance theory that a selective difficulty with spontaneously inferring the likely content of someone else's mind from the full facts of that person's situation should correlate with poor understanding of metaphorical utterances. (Recall that, in some patients with schizophrenia, this mind-reading difficulty goes beyond any more generalised problems with suppressing prepotent inappropriate information.)

3. New Empirical Findings from Schizophrenia Research: Methods

In this section and the next, we present new empirical findings concerning the links between general mind-reading ability, a capacity to suppress prepotent

⁴⁰ Perner, Frith, Leslie and Leekam (1989).

⁴¹ BM also succeeded on the Sally-Anne task (Baron-Cohen, Leslie and Frith, 1985) when, having seen a marble being moved from one position to another position while Sally was out of the room, he was asked, 'Where will Sally look for her marble?'

The Smarties task and the Sally-Anne task are both *first-order* false belief tasks. But BM's profile of performance cannot be adequately explained in terms of intact first-order mind-reading and impaired second-order mind-reading. For BM failed to appreciate the humour of most mental state jokes, which, judging by the illustration provided in the Corcoran, Cahill and Frith (1997) paper, required only a first-order inference about a cartoon character's mistaken belief. Perhaps BM, and other adults with acquired theory-of-mind impairments, can pass very simple theory-of-mind tasks even without a general ability to work out what another person is likely to believe given the facts about that person's situation. For example, subjects can pass the Smarties test by simply responding on the basis of what they said previously (i.e. before seeing that the Smarties box actually contained pencils) when asked what was in the box. And perhaps adults can pass the Sally-Anne test by relying solely on social/situational schematic knowledge.

inappropriate information, understanding of metaphorical speech and understanding of ironical speech in patients with schizophrenia and in healthy controls. These findings are based on data collected by Langdon (1999) in a series of investigations of executive functioning, theory of mind and understanding of non-literal speech in patients with schizophrenia and in non-clinical psychosis-prone individuals.⁴²

3.1 The Participants

A total of twenty-five patients, including eight inpatients and 15 outpatients, with a *DSM-IV* diagnosis of schizophrenia or a related disorder took part in the study.⁴³ All patients were receiving medication at the time of the study. Age of illness onset ranged from 16 to 37 years (mean of 23.2 years) and duration of illness ranged from two to 27 years (mean of 9.6 years). Twenty healthy controls were recruited from the general community and from amongst mature-age Psychology students who were participating in research as part of their course requirements. Controls were screened for the presence of affective and psychotic symptoms and were matched to the patient group on age, sex and educational level. All participants were Australian-born and had English as their first language.

3.2 The Testing Materials

3.2.1. The Picture-sequencing Task General mind-reading ability was tested using a picture-sequencing task. The original version of this task was developed by Baron-Cohen, Leslie and Frith (1986) in order to investigate theory-of-mind abilities in autistic individuals. In that study, Baron-Cohen and colleagues used three types of stories:

- (a) *false-belief* stories that depicted story characters acting on the basis of false beliefs;
- (b) *social-script* stories that depicted people acting out everyday social routines and tested logical reasoning using social-script knowledge involving no appreciation of mental states; and
- (c) *mechanical* stories that depicted cause-and-effect sequences (involving objects or people and objects) and tested ability to infer causal relations.

⁴² A more detailed examination of the complex interrelationships between executive deficits, theory of mind impairments and pragmatics deficits in patients with schizophrenia and how these deficits relate to the heterogeneous nature of schizophrenic symptomatology can be found in Langdon, Coltheart, Ward and Catts (in preparation).

⁴³ Twenty-three patients had a diagnosis of schizophrenia and two were diagnosed with schizoaffective disorder.

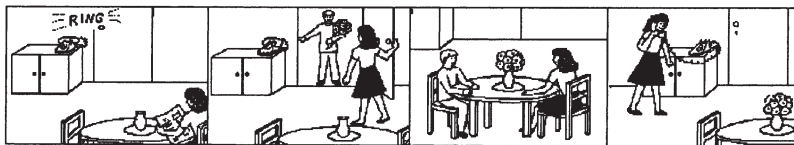


Figure 1 Picture sequence for capture story

Baron-Cohen *et al.* (1986) found that high-ability autistic individuals had greater difficulty than Down's syndrome and normal preschool children in sequencing *false-belief* stories whilst being at least as good as, and sometimes better than, the two control groups with the other two story types. This task has been adapted and used by Langdon and colleagues (1997) to demonstrate the existence of general mind-reading impairments in patients with schizophrenia. In particular, these latter individuals, when treated as a group, showed significant difficulties when required to make spontaneous inferences about false beliefs in order to understand cause-and-effect sequences of behaviour, despite performing just as well as healthy controls on the non-mentalistic *mechanical* and *social-script* stories.

The ability to suppress prepotent inappropriate information was tested in the same picture-sequencing task using a set of 'capture' stories. *Capture* stories depict people acting in everyday situations where a highly salient misleading cue must be inhibited if subjects are to take account of other, less salient, story details that determine the correct order of a sequence. For example, in the picture sequence shown in Figure 1, a prepotent misleading cue is created in the first card of the correctly ordered sequence by positioning the word 'RING' (depicting a ringing sound) next to a telephone. Subjects who are captured by that association assume that the telephone is ringing and position the fourth card, depicting a woman speaking on the telephone, next to the first card. However, that positioning of cards is illogical given other subtler story details that determine the correct order of the sequence. In this particular example, the 'RING' is actually the ringing of a doorbell by a visitor (unseen in the first card). Whether a subject draws that inference or not is irrelevant: what is relevant is whether a subject can inhibit the strong misleading cue and pay attention to other less salient story details that determine the correct order.

Capture stories were inspired, in part, by picture sequences used by della-Malva and colleagues (1993) to investigate the adverse effects of strong routine associations on patients with frontal lesions who were found to make significantly more errors than healthy controls and controls with posterior lesions when sequencing stories that depicted strong misleading routine associations. It is of note, however, that the original picture sequences used by della-Malva and colleagues appear to have confounded the ability to suppress prepotent misleading information with mind-reading ability, since the illustration pro-

vided in that paper shows a story character being misled by a strong routine association and acting on a false belief. In contrast, the *capture* stories used in the present study disentangled that confound—that is, correct sequencing of *capture* stories depends upon an intact ability to suppress prepotent misleading information but places no demands on mind-reading.

The particular set of *capture* stories used for the present study has been used elsewhere in two previous studies. The first of these provided evidence that normal adults who are putatively at higher risk of psychosis show relatively poor mind-reading when compared to individuals at lower risk of psychosis, despite equivalent, and sometimes better, ability to suppress prepotent inappropriate information (Langdon and Coltheart, 1999). The second of these provided evidence that an impaired ability to suppress prepotent inappropriate information may explain some, but far from all, cases of poor mind-reading in patients with schizophrenia (Langdon *et al.*, 2001).

3.2.2. The Story-comprehension Task Understanding of metaphorical speech and understanding of ironical speech were tested in a story-comprehension task that presented short stories culminating in one of the characters in the story making a statement. The subjects' task was to judge 'yes' or 'no' as to whether it made any sense for that character to make that statement in that situation. Stories were designed to involve irony (half of these were cases of banter and half were cases of sarcasm), or an appropriate metaphor, or a literally appropriate statement. Stories were organised in pairs so that each statement used ironically in the context of one story played the part of a literally appropriate statement in the context of the other story. Given that there were two subtypes of irony (banter and sarcasm), each subject saw eight different types of story-statement pairs; four of these required a 'yes' response (for appropriate uses of banter, sarcasm, metaphor and literally appropriate statements) and four of these required a 'no' response. Stories and appropriate statements of each type were mismatched to create the 'no' conditions. In sum, across several versions of the task, every story appeared in every condition,⁴⁴ every statement used ironically was also used literally and stories and statements used in 'no' conditions were identical (but mismatched) to those used in 'yes' conditions.

By the term 'banter' we mean an ironical utterance where there was no intention to harm or to criticise; here the irony was playful and sometimes even complimentary. Banter typically took the form of a negative statement being used in a positive context. For example, a story character might say, 'Are you trying to ruin my day?', in the context of that second character having gone out of his way to try to cheer up the speaker. In contrast, the term 'sarcasm' refers to an ironical utterance where there was an intention to

⁴⁴ By 'every condition', we mean every condition for counterbalancing purposes—that is, 'yes' to irony (half banter and half sarcasm), 'yes' to metaphor, 'yes' to a literally appropriate statement, and the various 'no' conditions.

harm or criticise. Sarcasm typically took the form of a positive statement being used in a negative context. For example, a story character might say, 'That was clever', in the context of a younger brother having carelessly broken a toy. Finally, metaphorical utterances took the form of either nominal metaphors (e.g. 'This job is a jail') or figurative expressions (e.g. 'You've got too many balls in the air').

To illustrate, a story such as:

Peter has a date with Jane, a new girl at his high school. It's their very first date. He's not supposed to meet Jane until 7pm. But he's so excited. He's already dressed and completely ready and it's only 5pm. He rushes down the stairs to grab his keys and nearly trips over the cat. His mother calls out . . .

might appear with any one of the following appropriate utterances:

'You're bound to be late at this rate!' (appropriate if interpreted ironically, subtype banter);
 'Hey, put the brakes on!' (appropriate if interpreted figuratively); and
 'You don't need to be in such a rush!' (literally appropriate).

3.2.3. The Spot-the-Word Test The Spot-the-Word test (Baddeley, Emslie and Nimmo-Smith, 1993) was also included in the experimental protocol primarily to provide a measure of baseline vocabulary (of most relevance to the story-comprehension task). An individual's performance on this task, however, is also taken to provide a more general index of verbal intelligence and, in some populations, a measure of premorbid IQ (O'Carroll, 1995; Yuspeh and Vanderploeg, 2000).⁴⁵

3.3 Procedure and Scoring

In the Spot-the-Word (STW) test, subjects were shown 60 pairs of items comprising one real English word (ranging in frequency from common to very rare) and one nonsense word and were asked to identify the real word. STW scores ranged from zero to 60.

At the start of the picture-sequencing task, subjects were given instructions and practice (with feedback) using two trial sequences. The sixteen experimental picture sequences (four for each story type: *social-script*, *mechanical*, *capture* and *false-belief*) were then presented in a random order. For each sequence,

⁴⁵ Whether or not that is also the case for patients with schizophrenia is questionable since schizophrenia often onsets quite early in life (typically in the teenage years) with consequent disruption to normal educational progression.

cards were placed face down in front of subjects in a random arrangement and subjects were asked to turn the cards over and to arrange them in the correct order (i.e. to show a logical sequence of events). The experimenter recorded the order in which cards were arranged and time taken. A mean position score, ranging from zero to six (the higher the score the fewer the position errors), was calculated for each story type.⁴⁶

For the story-comprehension task, stories, up to the point where a story character was about to make a statement, were presented on a computer monitor. Participants read these stories at their own pace and, when ready to see the story character's statement pressed a 'NEXT' button. The story character's statement then appeared, highlighted in green, below the story, which remained on the screen. Subjects used a response pad to judge 'yes' or 'no' as to whether it made any sense for the character to make that statement in that situation. Subjects were given instructions and shown three examples where the correct answer was 'yes'. These included a story paired with a literally appropriate statement, a story paired with an appropriate metaphor, and a story paired with an appropriate ironical utterance. They were then shown an example where it made absolutely no sense for the story character to make that statement in that situation. Following each example, subjects were asked if they understood why the correct answer was 'yes' or 'no'. If they were uncertain, the instructor explained that it was correct to say 'yes', not only when the statement was straightforwardly correct, but also when the statement could be interpreted as a figure of speech or a situation where the speaker was being sarcastic or a bit of a joker.⁴⁷ After the examples, participants were given practice with eight randomised stories; four required a 'yes' response (one each for banter, sarcasm, metaphor, and a literally appropriate statement) and four required a 'no' response. During practice, subjects were given 'CORRECT' or 'INCORRECT' computer feedback for each of their responses. After practice, the experimental stories were presented in a random order without feedback. The computer recorded errors and response latencies from the time that a story character's statement appeared on the screen to the time that a 'yes' or a 'no' button was pressed. Hit rates and false alarm rates were calculated for each type of utterance (banter, sarcasm, metaphor, and literally appropriate)

⁴⁶ See Langdon and Coltheart, 1999, for details of scoring.

⁴⁷ Since thought disorder is a feature of schizophrenia, it is common in experimental work with schizophrenic patients to ensure that task instructions are fully understood and to forewarn participants of what to expect in a task. In this study, patients appeared to have no difficulty in understanding what it meant to say that a speaker was being sarcastic or a joker. With such a procedure, it is unlikely that patients will perform at 100% failure rates. However, what would be expected, if patients do have an on-line difficulty with tapping the processes necessary for interpreting metaphorical speech and ironical speech, is that patients will be more likely than controls to miss appropriate uses of metaphor and irony and/or will be slower than controls at identifying appropriate uses of metaphor and irony.

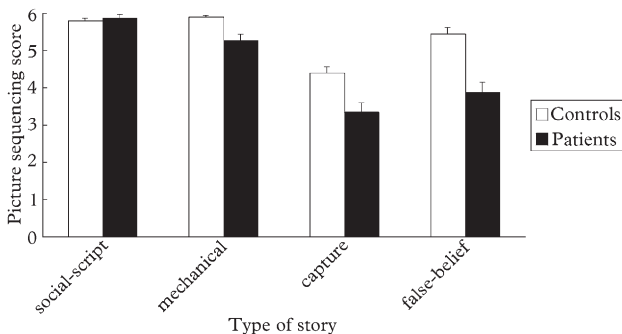


Figure 2 Mean position scores of patients and controls for each type of story (social-script, mechanical, capture, and false-belief), adjusting for verbal IQ

and time taken for correct judgements was averaged over six conditions: yes-irony, yes-metaphor, yes-literal and the three corresponding 'no' conditions.⁴⁸

4. New Empirical Findings from Schizophrenia Research: Results

4.1 Verbal Intelligence

The Spot-the-Word (STW) scores of patients were significantly lower, on average (44.4 ± 6.4), than those of controls (51.8 ± 3.8) [$t_{43} = 4.53$, $P < .01$]. Furthermore, the STW scores significantly predicted overall picture-sequencing performances across both subject groups (patients and controls) [$F(1,42) = 4.28$, $P < .05$] suggesting that this measure does provide an index of more general intelligence levels. These findings suggest that the particular group of patients sampled in this study, although matched to the controls on level of formal education, may have had lower general intelligence levels (on average) than the group of controls. Consequently, all subsequent analyses comparing the performances of patients and controls make appropriate statistical adjustments for the lower STW scores of patients.

4.2 Picture Sequencing

Figure 2 plots the picture-sequencing scores of patients and controls for each type of story (*social-script*, *mechanical*, *capture*, and *false-belief*) having made appropriate adjustments for the lower STW scores of patients. The primary interest

⁴⁸ It was necessary to collapse the two irony conditions (sarcasm and banter) since three patients correctly identified only one banter item, thus rendering the banter response time measure for these patients unreliable.

here is in whether or not patients and controls differed in their profiles of picture-sequencing ability across the various types of stories. Indeed they did; there was a significant interaction of subject group by type of story [$F(3,129) = 10.22, P < .001$]. As found elsewhere (Langdon *et al.*, 2001), patients made significantly more errors than controls when sequencing both the *capture* stories testing ability to suppress prepotent misleading information [$F(1,42) = 7.43, P < .01$] and the *false-belief* stories testing mind-reading [$F(1,42) = 14.44, P < .001$], despite performing just as well as controls on the *social-script* stories testing ability to reason logically about social behaviour without needing to take account of mental states [$F(1,42) = .17, P = .68$]. However, unlike the previous studies, patients in this sample also made significantly more errors than the controls when sequencing the *mechanical* stories that tested physical cause-and-effect reasoning [$F(1,42) = 6.88, P < .05$].

This set of data raises some doubts about the poorer performances of patients on the *false-belief* stories. That is, the reason that patients in this sample made more errors than controls when sequencing the *false-belief* stories might have had nothing to do with a specific mind-reading problem, and might instead have reflected general problems with cause-and-effect reasoning and/or inhibitory suppression. The finding that the *capture* picture-sequencing scores of patients predicted their *false-belief* scores [$r = .57, P < .01$] is consistent with that view. Indeed the correlation between the *mechanical* scores and the *false-belief* scores of patients was also suggestive, although clearly non-significant [$r = .30, P = .14$]. Logistic regression analyses were therefore carried out to determine whether, in at least some patients, poor *false-belief* picture sequencing reflected a specific mind-reading problem that could not be accounted for by more generalised deficits of cause-and-effect reasoning or inhibitory suppression. The log L-R (likelihood reduction) chi-square statistic testing the significance of the reduction in predictive power when the *false-belief* picture-sequencing score was removed from the full predictive equation (containing all relevant task variables⁴⁹) was highly significant [$\chi^2 = 7.47, P < .01$].

To summarise the main findings for this sub-section, the patients who took part in this study showed signs of greater cognitive impairments than patients sampled in previous studies. Nevertheless, the results of the logistic regression analysis—in particular, the finding that *false-belief* picture-sequencing scores still discriminated patients from controls even when all other task variables had been taken into account—clearly support the view that there exists a domain-specific mind-reading capacity that is impaired in some patients with schizophrenia. On this point, however, we do remind the reader of the highly significant correlation between the *capture* picture-sequencing scores and the *false-belief* picture-sequencing scores of patients. The implication here is that some

⁴⁹ The STW score (indexing verbal IQ), the *mechanical* picture-sequencing score (indexing physical cause-and-effect reasoning), and the *capture* picture-sequencing score (indexing inhibitory control), as well as the *false-belief* score.

patients, although clearly not all, show poor mind-reading because of a more generalised problem with suppressing prepotent but inappropriate information.

4.3 Story Comprehension

Response times, hit rates and false alarm rates of patients and controls on the story-comprehension task were then compared, adjusting for the lower STW scores of patients. In brief, there was little to be learned from the response time results. When patients were able to make the correct response, whether to accept an appropriate utterance or to reject an inappropriate utterance, they were no slower than controls, regardless of the type of utterance. Furthermore, the analysis of false alarm rates revealed that patients and controls did not differ significantly in their ability to identify and reject a statement that made absolutely no sense in the conversational context. That is, patients were just as capable as controls of using the story context in order to recognise a mismatch between the context and the utterance, once the influence of lower verbal IQs in some patients had been taken into account.

Where significant differences were found was in the hit rate results. Figure 3 plots the hit rates of patients and controls for the four types of utterance (banter, sarcasm, metaphor and literally appropriate statements), having adjusted for the lower STW scores of patients. If we consider just the two types of irony first, although patients clearly had a significant difficulty with accepting both types of irony when compared to the healthy controls, their profile of performance across the two types of irony did not differ significantly from that of the controls. That is, both patients and controls were significantly more likely to accept appropriate uses of sarcasm than they were to accept utterances that could be interpreted as banter [$F(1,43) = 17.07, P < .001$], and this differential pattern was no more marked for patients than it was for controls.

Overall, there was a highly significant interaction in the hit rate results [$F(3,129) = 5.26, P = .002$]. That is, the patients and the controls differed significantly in their profiles of performances across the four types of utterances. Simple contrasts revealed that patients, who did not differ significantly from controls in their ability to recognise and accept statements that were literally appropriate, were significantly impaired in their ability to recognise appropriate uses of all types of non-literal speech, whether banter, sarcasm or metaphorical speech—and those impairments were highly significant [all P -values $< .005$].

The question now is: Why do patients with schizophrenia have difficulty understanding these different types of non-literal speech?

The first possibility is that patients may fail to recognise appropriate uses of non-literal speech because of a more fundamental difficulty with suppressing prepotent inappropriate information; we already know that this is a problem in this group of patients, given their poor *capture* picture-sequencing scores. To investigate that possibility, the correlations between the *capture* picture-sequencing scores of patients and their hit rates for metaphorical speech and

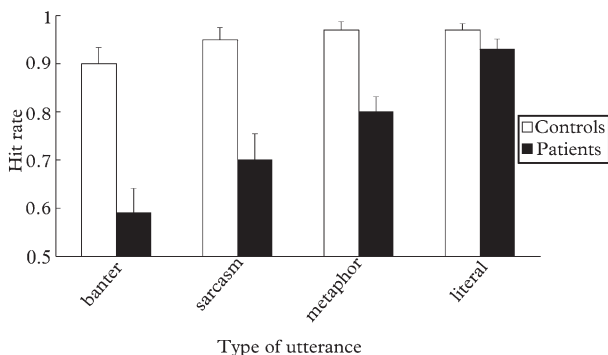


Figure 3 Hit rates for patients and controls (adjusted for the lower verbal IQs of patients) when asked to identify appropriate uses of banter, sarcasm, metaphorical utterances and literally appropriate statements

ironical speech⁵⁰ were examined. Although neither result was significant at the .05 level, there was a strong tendency for the *capture* picture-sequencing scores of patients to predict both their metaphor hit rates [$r = .38$; $P = .06$] and their irony hit rates [$r = .35$; $P = .09$]. That is, the better the patients were at suppressing prepotent inappropriate information when sequencing the *capture* stories, the more likely they were to recognise appropriate uses of metaphorical speech and ironical speech. The implication here is that some patients with schizophrenia may fail to understand non-literal uses of language because of a more pervasive problem with suppressing prepotent inappropriate information.

If that is so, then the next question is: Does this problem with being able to inhibit prepotent inappropriate information explain the difficulty that all patients have when they try to understand non-literal speech?

A logistic regression analysis, similar to that reported earlier, was used to answer this question. In brief, both the metaphor hit rate and the irony hit rate significantly discriminated patients from controls, even when the known difficulty that some patients have with inhibitory suppression had been taken into account [both P -values $< .001$]. Hence, something else, something more specific than a general problem suppressing prepotent inappropriate information, causes some patients with schizophrenia to have difficulty recognising appropriate uses of non-literal speech, whether metaphorical speech or ironical speech.

The next question is: Is this something else (this something that goes beyond a general impairment of inhibitory suppression) the same thing when

⁵⁰ Since patients and controls did not differ in their profiles of performance across the two types of irony, an overall irony hit rate was calculated by averaging the hit rates for banter and sarcasm.

a patient fails to understand metaphorical speech and when a patient fails to understand ironical speech?

In order to answer that question, the irony hit rate, the metaphor hit rate, the *capture* picture-sequencing score (indexing inhibitory suppression), and the STW score (indexing verbal IQ) were used as independent variables in a logistic regression analysis predicting the odds that an individual participating in this study was a patient or a control. Both the metaphor hit rate and the irony hit rate made highly significant and *independent* contributions to predicting the odds of being a patient [both P-values <.01]. Hence, it cannot be the case that an impairment of precisely the same set of processes causes patients with schizophrenia to have difficulty understanding metaphorical speech and difficulty understanding ironical speech.⁵¹

Finally, separate regression analyses were carried out to determine whether a patient's general mind-reading capacity predicts their understanding of metaphorical speech and their understanding of ironical speech. Only the latter proved to be the case—that is, the *false-belief* picture-sequencing scores of patients predicted their irony hit rates [$t = 2.63$; $P = .02$], but not their metaphor hit rates [$t = .93$; $P = .36$], once the contribution of other factors⁵² had been taken into account.

We now summarise the main findings for this sub-section. All participants (whether patient or control) were more prepared to accept sarcasm than they were to accept banter.⁵³ The results concerning possible differences between patients and controls (once allowances had been made for the lower verbal IQs of patients) showed that patients were just as capable as controls of using the story context in order to reject statements that made no sense in the conversational context and in order to accept statements that were literally appropriate in the conversational context. Despite this, however, patients were significantly impaired in their ability to recognise appropriate uses of all types of non-literal speech, whether banter, sarcasm or metaphor. As for why

⁵¹ Six patients had irony hit rates within the normal range (mean for controls ± 2 SD) and metaphor hit rates that were below normal. Three patients had metaphor hit rates within the normal range and irony hit rates that were below normal. Another four patients were near normal on metaphor (only 2.12 SDs below the mean for controls) but well below normal on irony.

⁵² Verbal IQ (indexed by the STW score), general cause-and-effect reasoning (indexed by the *mechanical* picture-sequencing score), and inhibitory suppression (indexed by the *capture* picture-sequencing score).

⁵³ Banter statements typically took the form of a negative statement being used in a positive context, whereas the reverse was true for sarcasm. So this result serves to replicate the finding of Kreuz and Glucksberg (1989) that positive statements used critically are appreciated as ironical more readily than negative statements used positively. This asymmetry occurs, so it is argued, because positive statements allude to expected norms of behaviour (being helpful or getting things right) and thus do not require explicit statements of the expectations being echoed. No such normative expectations exist for negative statements being used ironically and so banter is less readily accepted, unless the listener is made explicitly aware of some antecedent event which makes the irony tangible.

patients show these impairments, there was some evidence to suggest that a more fundamental difficulty with suppressing prepotent inappropriate information contributes to the problems that some patients have when required to recognise appropriate uses of both metaphorical speech and ironical speech. But that cannot be the full story. Both understanding of metaphorical speech and understanding of ironical speech significantly discriminated patients from controls even when the known difficulty that some patients had with inhibitory suppression had been taken into account. On the question of whether or not understanding of metaphorical speech and understanding of ironical speech tap precisely the same set of processes, the results of the logistic regression analysis supported the view that different patients with schizophrenia fail to understand metaphor and fail to understand irony for dissociable reasons.

As for what it is that is involved in understanding of ironical speech but is not involved in understanding of metaphorical speech (and goes beyond any more generalised capacity for inhibitory suppression), the findings of this schizophrenia study suggest that not just a basic ability to attribute mental states but the more sophisticated mind-reading abilities of the kind needed to pass typical theory-of-mind tasks are critical for understanding ironical speech. In contrast, understanding of metaphorical speech may require only a very basic ability to represent mental states; this we know is intact in patients with schizophrenia.

And as for what it is that is involved in understanding of metaphorical speech but not involved in understanding of ironical speech (and goes beyond any more generalised capacity for inhibitory suppression), that is an intriguing question and one that the findings of this study cannot directly address.

5. Summary and Conclusions

The findings from this investigation of non-literal speech comprehension in patients with schizophrenia and in healthy controls provide support for five propositions concerning the role of normal mind-reading in normal communication and the nature of cognitive processes underlying normal utterance interpretation.

1. Suppression of prepotent response tendencies is required both for normal mind-reading (of the kind measured by typical theory-of-mind tasks) and for normal interpretation of metaphor and irony (but is not sufficient for either).
2. Interpretation of metaphor and interpretation of irony involve distinct cognitive processes. Over and above a capacity to suppress prepotent response tendencies, there is something needed to understand irony which is selectively compromised in some patients with schizophrenia, and there is something entirely different needed to understand metaphor which is also selectively compromised in some patients with schizophrenia.

3. In the course of normal development, adults acquire a set of sophisticated domain-specific cognitive processes for working out what beliefs another person is likely to have given the facts about that other person's situation. In patients with schizophrenia, these domain-specific mind-reading processes have become disrupted later in life, following the onset of a psychotic breakdown. (What remains intact in these individuals is a basic ability to represent people's mental states.)
4. It is the disruption to normal adult mind-reading processes that causes some patients with schizophrenia to have selective difficulties with the interpretation of irony. This is consistent with the echoic theory of irony. In particular, it is consistent with the idea that interpreting irony depends crucially on appreciating, given the full circumstances of an ironical speaker's situation, that the speaker's attitude towards an echoed thought is one of rejection or dissociation.
5. In contrast with the case of irony, the full sophistication of normal adult mind-reading processes is not necessary for the interpretation of metaphor. This is consistent with relevance theory's distinction between metaphor, as a descriptive use of language, and irony, as an interpretive use of language.

A question for future research is what the distinctive additional factor in metaphor interpretation might be. According to (2), it is a factor that goes beyond suppression of prepotent response tendencies; and according to (3), (4) and (5) it is not any aspect of mind-reading ability. There are empirical findings that support the hypothesis that some patients with schizophrenia have disorganised or degraded 'semantic networks' or knowledge bases of logical and encyclopaedic information pertaining to concepts.⁵⁴ It would be broadly consistent with those findings to suggest that the factor that is distinctively necessary for metaphor interpretation is related to the ability to construct *ad hoc* concepts that share some, but not all, of the logical and encyclopaedic properties of the concepts that are linguistically encoded. This proposal needs further empirical investigation.

Overall, this study provides strong support for an approach to the study of communication that is informed by contemporary pragmatic theory. It also suggests that studying people with schizophrenia will make a substantial and vital contribution to the development of a full cognitive science of communication. In line with the aims and methods of cognitive neuropsychology, the investigation of people with late-onset disorders of cognition is helping us to

⁵⁴ Goldberg *et al.*, 1998; Goldberg and Weinberger, 2000; Laws *et al.*, 1999; Spitzer, 1997.

learn about how the normal cognitive system operates for the comprehension of literal speech, metaphor and irony.

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