Available online at www.sciencedirect.com
SCIENCE DIRECT®
Brain and Language 98 (2006) 12–25
Brain and Language
www.elsevier.com/locate/b&l

Neuropragmatics: Extralinguistic pragmatic ability is better preserved in left-hemisphere-damaged patients than in right-hemisphere-damaged patients

Ilaria Cutica *, Monica Bucciarelli, Bruno G. Bara

Center for Cognitive Science and Department of Psychology, University of Turin, via Po, 14 Turin 10123, Italy

Accepted 4 January 2006
Available online 28 February 2006

Abstract

The aim of the present study is to compare the pragmatic ability of right- and left-hemisphere-damaged patients excluding the possible interference of linguistic deficits. To this aim, we study extralinguistic communication, that is communication performed only through gestures. The Cognitive Pragmatics Theory provides the theoretical framework: it predicts a gradient of difficulty in the comprehension of different pragmatic phenomena, that should be valid independently of the use of language or gestures as communicative means. An experiment involving 10 healthy individuals, 10 right- and 9 left-hemisphere-damaged patients, shows that pragmatic performance is better preserved in left-hemisphere-damaged (LHD) patients than in right-hemisphere-damaged (RHD) patients.

Keywords: Neuropragmatics; Extralinguistic communication; Left-hemisphere-damaged patients; Right-hemisphere-damaged patients

1. Pragmatics in right- and left-focal brain damaged patients

Historically, the right hemisphere of the brain has been considered to be involved in the pragmatic aspects of communication, but most studies on RHD patients have only tested their linguistic communicative ability. Thus, "pragmatic ability" has usually been intended as "linguistic pragmatic ability." Several studies focus on the ability of RHD patients to deal with a specific kind (or family) of pragmatic phenomenon, such as jokes, metaphoric language (Winner & Gardner, 1977), humor (Brownell, Michelow, Powelson, & Gardner, 1983), sarcastic utterances (McDonald, 1996; Weylman, Brownell, Roman, & Gardner, 1989), and indirect speech acts (Stemmer, Giroux, & Joanette, 1994; Weylman et al., 1989). Taken together, those studies reveal that most RHD patients are impaired in processing non-literal speech acts in which the listener has to identify the speaker's intention. In particular, studies on indirect speech acts show that patients tend to interpret the sentences literally, suggesting that in understanding the speaker's intention they rely heavily on the literal meaning of sentences.

Other authors focus on high-level abilities that affect pragmatic competence. For instance, numerous studies have found that RHD patients have deficits in structuring and organizing (e.g., Joanette, Goulet, Ska, & Nespoulous, 1986; Myers, 1994), in interpreting (e.g., Kaplan, Brownell, Jacobs, & Gardner, 1990), and in inferring from (e.g., Beeman, 1993) the information in narrative and conversational discourse. RHD patients also have a difficulty that is attributable to the supra-sentential level, such as deficits in judging whether a fact is plausible or not with reference to a given context (Roman, Brownell, Potter, & Seibold, 1987). More in general, RHD patients seem to be impaired in using context to interpret speech acts (Kaplan et al., 1990; Richards & Chiarello, 1997), and they "miss the point" of complex discourse, particularly in oral conversation (Gardner, Brownell, Wapner, & Michelow, 1983; Hough, 1990).

* Corresponding author. Fax: +39 011 8159039.
E-mail addresses: cutica@psych.unito.it (I. Cutica), monica@psych.unito.it (M. Bucciarelli), bara@psych.unito.it (B.G. Bara).

0093-934X/$ - see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.bandl.2006.01.001

Some studies focus on the possible causes underlying the pragmatic deficits of RHD patients. Most of them assume a deficit in the ability to draw inferences (e.g., Beeman, 1998; Joanette & Goulet, 1986; Molloy, Brownell, & Gardner, 1990), and argue that such a deficit results in difficulty in establishing or increasing coherence. As a result, RHD patients are impaired in deriving the gist meaning of speech acts and texts (e.g., Beeman, Bowden, & Gernsbacher, 2000).

Summarizing, all the evidence found in the literature supports the idea that the RH is heavily involved in pragmatic ability, considered as the ability to use language properly in a social context. But what happens if we consider pragmatic ability as the ability to communicate properly through extralinguistic means rather than through language? Indeed, pragmatic ability is the ability to conduct a communicative interaction properly in a given social context; language is not our only communicative tool: gestures are communication.

As mentioned above, most studies in this field investigate patients' pragmatic ability through linguistic means; this could raise problems in that patients could possibly partially compensate for their pragmatic deficit by using their linguistic ability. Indeed, we know from the literature that RHD patients preserve their ability to manage the syntactic aspects of sentences, and largely rely on their intact syntactic ability in processing the discourse (Brownell, Carroll, Rehak, & Wingfield, 1992). Therefore, it is possible that syntax facilitates patients' comprehension of an actor's communicative intention, when that intention is expressed linguistically. If this is the case, then patients should find it easier to comprehend linguistic rather than extralinguistic communication. And indeed, Cutica (2005) finds that RHD patients have more difficulty in comprehending extralinguistic pragmatic phenomena than linguistic pragmatic phenomena. On the basis of such literature, we consider it important to examine both the linguistic and extralinguistic factors of pragmatic ability. This also allows us to test populations such as LHD patients, whose pragmatic ability is difficult to test through linguistic means.

Numerous studies have shown that in left-hemisphere-damaged (LHD) patients global aspects of discourse production (e.g., Ernest-Baron, Brookshire, & Nicholas, 1987; Holland, 1982) and discourse structure (Ulatowska, Freedman-Stern, Doyel, Macaluso-Haynes, & North, 1983) are relatively preserved. Furthermore, some studies suggest that LHD patients can be facilitated in understanding a linguistic communication when the content of the communication is emotional (e.g., Borod et al., 2000): indeed, emotional content can facilitate pragmatic performance in LHD patients, and suppress it in RHD patients (Bloom, Borod, Obler, & Koff, 1990).

As regards the differences between the two hemispheres in processing the meaning of a verbal communication, some evidence is found in studies on the contribution of the RH to language comprehension in neurologically intact individuals via the use of lateralized stimuli (see, e.g., Coulson, Federmeier, Van Petten, & Kutas, 2005), a research paradigm based on the fact that a stimulus presented outside the center of the gaze is initially processed only by the contralateral hemisphere (Hellige, 1983; Zaidel, 1983). For instance, Faust (1998) and Faust and Gernsbacher (1996) find that the RH primarily processes word-level meaning, whereas the LH has the ability to integrate syntactic, semantic and pragmatic information. However, other studies on the ability of RHD patients to comprehend discourse are inconsistent with this claim. In particular, they suggest that the RH operates primarily at the message level. A study conducted by Coulson and colleagues (2005) using lateralized stimuli, reveals that both the LH and the RH exploit the word- and the sentence-level context, especially in processing congruous sentences. Only with incongruous sentences it is possible to find some difference: whereas the LH only take care of the lexical relationships when the sentence integration process fails, the RH consider the lexical relationships at any step of sentence processing.

Despite the sometimes inconsistent findings of the studies on the contribution of the two hemispheres in the process of comprehending a communication act, all the experimental works on LHD patients supply evidence of an impairment in understanding language. For this reason, there is a risk, when evaluating the pragmatic ability of LHD individuals through tests that use language, of interpreting poor performance as being due to a pragmatic impairment, when instead it is due to a linguistic deficit.

2. Cognitive pragmatic theory

The main aim of the present work is to compare the extralinguistic pragmatic performances of RHD and LHD patients. As we saw in Section 1, in the current literature linguistic pragmatic competence is ascribed to the right hemisphere: we intend to analyze the scarcely explored topic of extralinguistic pragmatic ability, and its connection with both the right and the left hemispheres. To this aim, we tested the ability of understanding several types of communication acts.

We follow the tenets of Cognitive Pragmatics Theory (Airenti, Bara, & Colombetti, 1993a, 1993b; a systematization is in Bara, 2005), within which communication is viewed as a form of social activity, and it can be seen as an agent's intentional and overt attempt to affect a partner's mental states. Individuals can express their communicative intentions not only with language, but also through extralinguistic means, that is any hand gesture, body movement or facial expression that is intentionally used to share a communicative meaning. When we refer to *extralinguistic communication*, we refer to gestures, most of the time symbolic, intentionally used by an actor to convey information to a partner in the absence of language.

Let us assume, for clarity of exposition, that the actor is a female, and the partner is a male. When the actor communicates, she executes a social action plan, called a *behavioral game*, the knowledge of which is shared between herself and her partner, with the aim of achieving a certain effect on the

latter (namely, to change his mental states and possibly to induce him to perform some action). The partner's task is to fully understand the actor's communicative intention through the recognition of the behavioral game. The process of comprehending a communication act consists in drawing inferences from the recognition of the expression act (i.e., the overt attempt to perform a communication act) to understand the communicative intention of the actor. The actor's communicative intention is only fully understood when it is clear to her partner which move of a behavioral game it realizes.

Communication can either be standard or non-standard. The difference between standard and non-standard communication can be expressed in terms of the mental representations involved (Bucciarelli, Colle, & Bara, 2003): if there is no conflict between what is expressed and what is privately entertained by the actor, the communication is standard. Standard communication comprises direct, conventional indirect and non-conventional indirect acts, where the beliefs and communicative purposes of the actor are in line with what she says. In terms of mental representations, in standard communication, the partner can refer the communication act to the actor's game without taking into account conflicting mental representations.

In case of conflict between what is expressed and what is privately entertained by the actor, the communication is non-standard. Deceit and irony are examples of non-standard communication, where the expression act of the actor contrasts with her private beliefs. In the case of comprehension of deceit, it is necessary to detect a difference between the mental states that are expressed and those that are privately entertained by the actor. An uttered statement becomes ironic when, along with this difference, the contrast between the expressed mental states and the scenario provided by the knowledge the actor shares with the partner is detected. Irony comprehension involves the detection of the contrast between a belief expressed by the actor and a belief shared with the partner.

From the assumptions above follows the prediction that standard phenomena are easier to comprehend than non-standard phenomena. The prediction is confirmed—in both the linguistic and extralinguistic pragmatic literature—for normal development (Bucciarelli et al., 2003) and abnormal development (Bara, Bosco, & Bucciarelli, 1999), in closed-head-injured patients (Bara, Tirassa, & Zettin, 1997; Bara, Cutica, & Tirassa, 2002), and in Alzheimer patients (Bara, Bucciarelli, & Geminiani, 2000).

Besides the presence of conflicts between what is communicated and what is privately entertained by the actor, Bucciarelli et al. (2003) proposed that a further factor may determine a difference in the difficulty involved in comprehending different pragmatic phenomena. This factor is the inferential load necessary to correctly refer the actor's communication act to the behavioral game the actor is playing, that is, the inferential load necessary to fully understand the actor's communicative intention. The necessity to build a longer chain of inferences is what discriminates between *complex* communication acts and *simple* communication acts. The difference between simple and complex acts is that the latter require a more complex chain of inferences to be referred to the actor's behavioral game. In standard communication, direct and conventional indirect acts are considered as *simple acts*, whereas non-conventional indirect acts are considered as *complex acts*. In non-standard communication, simple and complex types of each phenomena may be found, as for instance simple and complex deceits, and simple and complex ironies.

Let us consider examples of simple and complex standard acts. Examples of simple (conventional indirect) acts, both linguistic and extralinguistic, are the following:

[1] Two girls are in a room. One is standing near an open window.
Linguistic: The other girl says to her: "Would you mind closing the window?"
Extralinguistic: The other girl nods in her direction and staring at her points to the open window.

Whereas complex (non-conventional indirect) acts are the following:

[2] Two girls are in a room. One is standing near an open window.
Linguistic: The other girl says to her: "It's cold in here!"
Extralinguistic: The other girl nods in her direction, showing her that she is cold by pretending to shiver violently.

The gesture of pointing to the window in [1] requires a straightforward inference to be understood as a request to close the window. The gesture of pretending to shiver in [2], instead, requires further inferential steps to be derived from both the communicative gesture and the context: the partner has to recognize the gesture as a way of communicating that she is cold, he has to notice that the window is open, he has to believe that when the window is closed the temperature inside the room may rise, and considering all these elements he has to infer that the actor's gesture was actually a request to close the window.

In standard communication, when the communicative meaning is explicitly expressed in the communication act, the act is in its *simple* form; on the contrary, when the communicative meaning is not explicitly expressed in the communication act, the act is in its *complex* form.

Fig. 1 illustrates the two factors that determine the level of difficulty in comprehending different pragmatic phenomena (Bucciarelli et al., 2003): the presence/absence of conflicting mental representations, and the inferential load required to understand the actor's communicative intention.

Cognitive Pragmatics Theory assumes that, in the process of understanding the actor's communicative intention, the partner has to draw some inferences to ascribe the actor's communication act to the behavioral game she is playing. However, the theory also assumes that to understand a

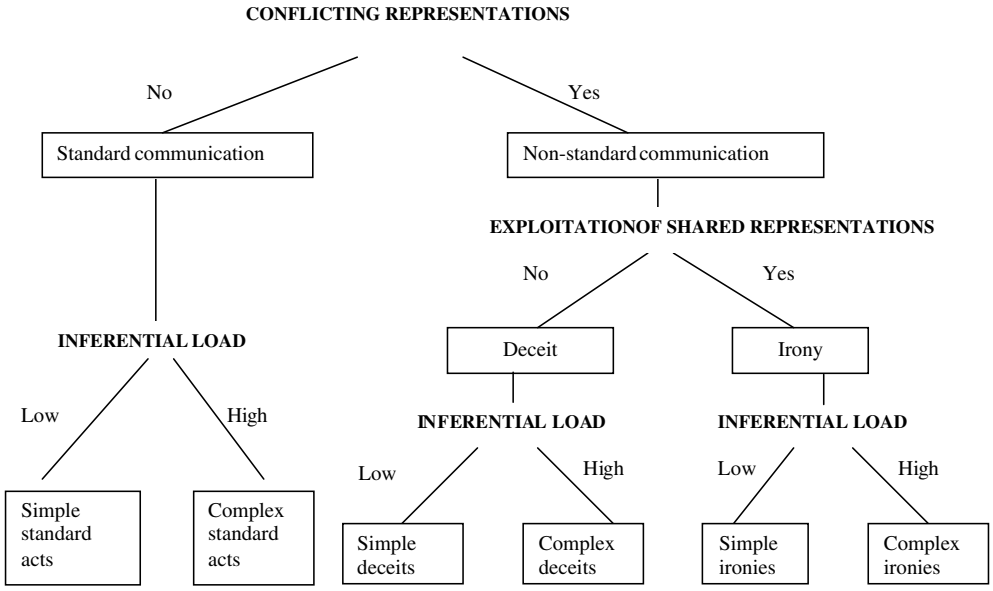

Fig. 1. Factors which determine the level of difficulty in comprehending different pragmatic phenomena (modified from Bucciarelli et al., 2003).

conventional indirect act, a very easy and straightforward inferential chain is required, as in the case of a direct act. Thus, the theory considers both sorts of communication act as pertaining to the same broader category of *simple standard acts*, and predicts that they are equally easy to comprehend. The prediction is confirmed for linguistic communication by a study on both healthy subjects and closed-head-injured patients conducted by Bara et al. (1997), as well as, for linguistic communication, by a study on RHD patients conducted by Champagne, Virbel, Nespolous, and Joanette (2003), who conclude that conventional indirect acts are "a type of indirect speech act that is increasingly thought to be processed readily, like any other direct request" (p. 156).

3. Experiment: Extralinguistic communication in RHD and LHD patients

The main aim of our study is to understand whether extralinguistic pragmatic ability pertains more to the right or to the left hemisphere. If the performance of LHD patients is comparable to that of RHD patients, then both hemispheres contributes to extralinguistic pragmatic ability. On the contrary, should the performance of LHD patients be equivalent to that of the control group (healthy people), and therefore better than that of RHD patients, then the left hemisphere contributes less to extralinguistic pragmatics than the right hemisphere.

A further aim of the work is to validate a series of predictions on the comprehension of extralinguistic communication. Our predictions can be summarized as follows.

Comparisons between groups

i. Patients versus controls. Both RHD and LHD patients perform worse than controls within each pragmatic phenomenon investigated.

ii. LHD patients versus RHD patients. The linguistic pragmatic literature suggests that pragmatic ability mostly relies on the RH. We might thus expect to find that the extralinguistic pragmatic performance of RHD patients is poorer than that of LHD patients.

Comparisons within groups

iii. Since understanding non-standard communication involves sorting out conflicting mental representations, non-standard communication should be more difficult to comprehend than standard communication both for patients and controls.

iv. Since both direct and conventional indirect acts require a single step inferential chain (they are both cases of simple standard acts), there should be no difference in difficulty in understanding them, both for patients and controls.

v. Since understanding a non-conventional indirect act requires a longer inferential chain than is needed to understand a direct or conventional indirect act, then simple standard acts (direct and conventional indirect acts) should be easier to comprehend than complex standard acts (non-conventional indirect acts) both for patients and controls.

3.1. Experimental setting

3.1.1. Materials

The pragmatic protocol comprises 15 short videotaped fictions, involving four pragmatic phenomena. It was originally devised by Bucciarelli and colleagues (2003) and it is illustrated in the Appendix A. It consists of 6 fictions involving simple standard acts, that is 3 direct acts and 3 conventional indirect acts; 3 fictions involving complex standard acts, that is non-conventional indirect acts; 3 fictions involving simple deceits and 3 involving simple

ironies. In Section 2 we claimed that communication acts of the *simple* sort are those involving the shortest possible inferential chain to be drawn to understand the actor's communicative intention. Each stimuli category in the pragmatic protocol is homogeneous with respect to this parameter. With the exception of the 3 non-conventional indirect acts, all the categories of items comprise acts of the simple sort: direct and conventional indirect acts, simple deceits, simple ironies. A simple deceit is a lie; a simple irony is an *antiphrastic* irony. In the classical pragmatic literature (Grice, 1975, 1978), understanding irony requires detection of the fact that the literal meaning of the sentence proffered is exactly the contrary of the meaning the speaker wants to communicate, such as, for instance, when the words "What nice weather" are spoken on a particularly gray day. In our terminology, such instances of antiphrastic ironies are instances of ironies of the simple sort. Many authors (Clark & Gerrig, 1984; Kumon-Nakamura, Glucksberg, & Brown, 1995; Morgan, 1990; Sperber & Wilson, 1981, 1986) have pointed out that understanding irony is not limited to reversing the meaning of the utterance, but it can require drawing complex inferential chains. In our terminology, ironies that require complex inferential chains are ironies of the complex sort.

Each fiction lasts about 16–20 s, and depicts a single communication act performed by an actor toward a partner. The agents in the communicative interactions differ from one fiction to the other. Each fiction ends immediately before the partner's reaction to the communicative gesture performed by the actor.

The classification of the stimuli does not depend upon the actual gesture performed by the actor, but upon the meaning of the gesture in the communicative context. Indeed, we sometimes used the same kind of gesture for different pragmatic categories: pointing can be part of a standard act, such as when it means "pass me the salt," as well as of a deceit, such as when it is used to mean that a person is in a certain place, whereas the actor (and the participant observing the fiction) knows he is in another place.

In the fictions depicting a direct act, the communicative gesture performed by the actor directly refers to the action the actor wants the partner to perform. In particular, the action is part of the behavioral game the actor wants to play with the partner. An example is the following:

[3] A boy (A) and a girl (B) are walking towards a car. A opens the car door for B.

In the fictions depicting a conventional indirect act, the communicative gesture performed by the actor identifies an object, leaving the partner to infer what he is requested to do with that object. However, the gesture is conventionally associated with a specific game performed in that specific context. An example is the following:

[4] A woman (A) is sitting at her desk holding a telephone receiver, a man (B) comes in. A points to a chair for B.

In the fictions depicting a non-conventional indirect act, the communicative gesture performed by the actor refers to a condition or a situation that has implications for the behavioral game at play. Unlike the conventional gesture, the gesture is not conventionally associated with a specific game. An example is the following:

[5] A child (A) is walking with his sister (B). They stop in front of a toy shop and A points insistently at a game. B shows him her empty purse.

In the fictions depicting a simple deceit (that is a lie), the communicative gesture performed by the actor aims at inducing the partner to believe the actor is playing a game different to that which the actor is actually playing. In particular, the actor's gesture identifies an object or a person that should induce the partner to believe something that the actor (and also the spectator observing the fiction) knows is not true. An example is the following:

[6] Two young boys, A and C, are playing together. A knocks a vase over. A boy (B) comes in and looks at them with a questioning look. A points to C.

Finally, in the fictions depicting a simple irony, the communicative gesture performed by the actor refers to a game that the actor is not actually playing, but unlike the deceit, here the actor wants the partner to recognize the actual game she is bidding. Thus, in the irony fictions, the communicative gesture performed by the actor is intended to mean the opposite with respect to the belief shared by the actor and the partner. An example of a fiction depicting a simple irony is the following:

[7] Two children, A and B, are playing with Lego. Together they are building a fairly high tower. B knocks the tower over. A claps.

At the end of each fiction, the experimenter presents the participant with a large photograph (29.5×21 cm) reproducing the last frame of the fiction, that typically depicts the actor's communicative gesture. In each photograph a white balloon is pasted above the actor's head, such as in a comic strip, that must be filled in by choosing one among four photographs randomly introduced by the experimenter; only one of them represents the communicative intention of the actor. For instance, in the fiction described in [3] (direct act) the four alternative response-pictures show: B while getting into the car; A while getting into the car; B playing with a doll; A making a phone call. In the fiction described in [4] (conventional indirect act) the pictures show: B sitting on the chair that A pointed to; B sitting on the floor; A combing her hair; B lying on a sofa. All of the other sets of alternative response–pictures are described in the Appendix A. With this testing procedure, language plays no role in the extralinguistic protocol, since it appears neither in the material presented, nor in the response requested.

The four alternatives were assembled according to the following criteria. One response is correct, the other three are wrong. One of the erroneous alternatives was intended to be misleading. It depicts a situation that is not the correct interpretation of the actor's communicative intention, but is still consistent with the scene. In particular, for direct and conventional indirect fictions, the misleading alternative depicts the partner doing something different with respect to the action the actor invited him to do; the different action, although clearly wrong, has something to do with the story: for instance, it involves an object already mentioned. The misleading alternative for non-conventional indirect fictions, in which the actor always induces the partner not to perform a certain action, consists in the partner performing that action. The misleading alternative for simple deceit fictions corresponds to the literal meaning of the communicative act, and for simple irony fictions it corresponds to the event the actor does not want to occur.

For each fiction, the other two wrong alternatives depict scenarios (situations or objects) that are inconsistent with the previous interaction: they are clear mistakes, having nothing to do with the interaction actually at play, although all of them involve the same characters. In the Appendix A, the alternatives labelled (a) are the correct answers, the alternatives labelled (b) are the erroneous misleading answers, and the alternatives labelled (c) and (d) are the erroneous answers that have nothing to do with the communicative gesture.

3.1.2. Procedure

The participants dealt with the experiment individually, in a quiet room. They were told that the experiment was concerned with human communicative ability. For patients the procedure consisted of two parts. The first involved them having to pass three entrance tests: the MMSE (*Mini Mental State Examination*), a theory of mind test (*Smarties test*), and a visuo-perceptive test. The Smarties test consists in showing the participant a Smarties box, and asking her/him what there is inside: she/he naturally answers that there are candies. Then the experimenter opens the box revealing that there are pencils inside. The participant is asked what a third person (not present in the room) will say when she/he is shown the box and is asked to say what is inside it. The test is passed when the participant answers that the third person will say that there are Smarties inside the box. The visuo-perceptive test consisted of four videotaped scenes, depicting objects in movement according to laws of physical causality, designed to test whether the patient could correctly perceive the whole screen of the television. The visuo-perceptive test was designed specifically for RHD patients: indeed, even though we selected the participants from among those RHD patients without neglect according to the hospital neuropsychologist's clinical evaluation, we wanted to be sure that all of them could correctly perceive the visual space where the fictions were shown. Therefore, we also took care, throughout the entire experimental session, to place all the visual material straight in front of the participants. Only patients who scored 26 or more in the MMSE and obtained full marks in both the Smarties and the visuo-spatial tests were admitted to the experimental session. In actual fact, none of the patients were excluded because all of them succeeded each test.

In the second session, which usually took place the week after, patients dealt with the pragmatic protocol. Control subjects only participated in the pragmatic session. The 15 fictions were presented to the participants in each group in one of two random orders, both designed so that two instances of the same pragmatic phenomenon never occurred on consecutive trials. The number of participants was balanced according to the two randomizations. At the beginning of the experimental session, to get the participants used to the task of ascribing a mental state to a character, and in particular to train them to the request of looking for a picture that represents a character's communicative intention, the participants dealt with a training session. In the training session the experimenter introduced a picture of Mickey Mouse with a balloon coming out from his head, and said: "Mickey Mouse invites Minnie to go to the beach"; then he showed four alternative pictures, only one of which represented the communicative intention of Mickey Mouse (i.e., Mickey Mouse and Minnie on the beach). The experimenter asked the participant to complete the balloon with Mickey Mouse's thought. If the participant chose the wrong balloon, the experimenter explained him or her the correct answer. Of the seven warm-up trials, none of the participants failed more than two. Immediately after the training session the participants were presented with the real experiment.

The experimenter showed the participant the videotaped fictions; at the end of each fiction the participants were shown the large photograph of the last frame of the fiction. The participants' task was to fill the white balloon that was pasted next to the head of the character who performed the communicative gesture, with a picture depicting the actor's communicative intention. Participants had to chose the correct communicative intention by choosing it from a set of four photographs presented in random order and placed above the large photograph. When the four photographs were presented, the experimenter said: "What does the character mean? Choose the corresponding photograph."

Participants did not have to explain their choice, unless they wanted to. To avoid their performance to be affected by possible short-term memory impairment, they were allowed to view the scene again, with no limitation of time. Only when an answer had been given, the subsequent fiction was shown. Each session lasted about 50 min for patients and about 35 min for controls. All the experimental sessions were audiorecorded.

We assigned one point for each correct answer, that is each time the participant correctly recognized the communicative intention of the actor.

3.1.3. Participants

One experimental group consisted of 10 right-brain-injured patients (7 males, 3 females), aged between 37 and 71 years (mean age: 62.9), and whose education ranged from 2 to 18 years (mean years: 8.5). All of them had

Table 1
Demographic, neurological, and neuroimaging data of RHD patients

Subject	Sex	Age	Years of education	Etiology	CT scan (frontal, temporal, parietal, and occipital)	Time post-onset (months)
1	F	60	13	Ischemia	FP	22
2	F	58	3	Brain hemorrhage	PT	4
3	M	61	8	Ischemia	FT	3
4	M	37	13	Ischemia	PO	1
5	F	44	8	Ischemia	PT	9
6	M	74	3	Ischemia	TP	8
7	M	76	13	Ischemia	PT	14
8	M	73	18	Ischemia	TP	5
9	M	83	13	Brain hemorrhage	TP	4
10	M	63	12	Ischemia	F	8

Table 2
Demographic, neurological, and neuroimaging data of LHD patients

Subject	Sex	Age	Years of education	Etiology	CT scan (frontal, temporal, parietal, and occipital)	Time post-onset (months)
1	F	35	13	Brain hemorrhage	FTP	20
2	M	44	13	Ischemia	FTP	15
3	M	71	5	Brain hemorrhage	PT	7
4	M	65	8	Ischemia	TP	5
5	M	80	13	Ischemia	FT	10
6	M	80	4	Ischemia	TP	5
7	M	55	6	Ischemia	PT	5
8	M	35	8	Brain hemorrhage	P	4
9	M	65	5	Ischemia	FT	7

suffered a vascular event (ischemia or hemorrhage). None of the RHD patients were apraxic as resulted from the Apraxia Subtest of the Western Aphasia Battery (Kertesz, 1982). The period of time which had elapsed between the onset of illness and testing ranged from 1 to 22 months ($M = 7.8$; $SD = 6.215$). Table 1 shows demographic and neurological data of RHD patients.

The other experimental group consisted of 9 left-injured patients (8 males, 1 female), aged between 35 and 73 years (mean age: 58.8), and whose education ranged from 3 to 18 years (mean years: 8.2). Each of them had suffered a vascular event (ischemia or hemorrhage). The time post-onset of illness ranged from 4 to 20 months ($M = 8.67$; $SD = 5.454$). Table 2 shows demographic and neurological data of LHD patients.

Patients in both groups attended a hospital in Turin for postacute neuropsychological, motor and speech rehabilitation. None of the patients in either groups had suffered more than one vascular event. The two groups of patients did not differ in terms of general intelligence. In particular, hospital personnel subjected each patient to several assessment tests; the results are shown in Table 3.

Finally, there was a control group made up of 10 healthy subjects corresponding to the two patients groups in terms of sex (7 males, 3 females), age (age ranging from 36 to 71 years; mean age: 61) and education (mean years: 9). Nobody in any of the groups had any previous or ongoing psychiatric problems, or alcohol or drug addiction.

4. Results

All patients passed both the theory of mind and the visuo-perceptive tests, and all of them obtained an MMSE score of more than 26; therefore all of them were admitted to the experimental sessions.

Before analyzing the results, we determined the severity level of injury in both groups. As a measure, we considered performance in the Raven Progressive Matrices Test, which is one of the tests that hospital personnel usually use to assess patients. The results show no significant difference between the two groups of patients (RHD patients' mean score: 10.40, $SD = 1.17$; LHD patients' mean score: 9.78, $SD = .83$; Mann–Whitney test: $z = -.443$, $p = .658$). Therefore, we can compare the performance of the two groups in the pragmatic tests.

We also verified, through non-parametric analyses of variance using the Friedman test, an implicit assumption of our study, namely that participants experienced the same degree of ease/difficulty in understanding the 3 stimuli that constitute each pragmatic category (e.g. the 3 ironic communication acts). The results reveal that all the communication acts of a given sort were comparable in difficulty for RHD patients (p value ranging from .115 to .529), for LHD patients (p value ranging from .549 to .819) and also for controls (p value ranging from .097 to .368).

Table 4 shows the mean correct performance by the three groups of participants for the different sorts of communication act.

Comparisons between-groups

i. Patients versus controls

As we performed several between-groups comparisons, to prevent multiple statistical contrasts from increasing the risk of obtaining false positives, we applied the Bonferroni correction for the three dependent variables (global perfor-

Table 3
Neuropsychological data of RHD patients and LHD patients

Subject	MMSE	Tower of London	Raven progressive matrices	Ray figure memory test	Diller test	
					Left omissions	Right omissions
1 RHD	29	21	9	1	0	0
2 RHD	29	17	11	1	2	2
3 RHD	29	26	10	1	2	0
4 RHD	27	21	10	1	0	0
5 RHD	30	22	11	1	0	1
6 RHD	29	17	9	0	5	2
7 RHD	28	16	9	1	0	0
8 RHD	28	22	11	1	0	0
9 RHD	29	24	12	1	0	0
10 RHD	27	16	12	1	2	0
Mean for RHD	28.5	20.2	10.4	0.9		
1 LHD	30	25	9	1	—	—
2 LHD	30	21	9	1	—	—
3 LHD	28	14	10	0	—	—
4 LHD	29	17	11	1	—	—
5 LHD	29	21	9	1	—	—
6 LHD	28	19	9	1	—	—
7 LHD	29	22	10	1	—	—
8 LHD	30	16	10	1	—	—
9 LHD	29	24	11	1	—	—
Mean for LHD	29.1	19.88	9.78	0.88		

We did not test LHD patients on the Diller test, a typical neglect test.

Table 4
Mean correct performance by RHD patients, LHD patients, and controls for each pragmatic task

	Standard acts			Non-standard acts	
	Simple		Complex	Simple deceits ($n=3$)	Simple ironies ($n=3$)
	Directs ($n=3$)	Convent. indirects ($n=3$)	Non-convent. indirects ($n=3$)		
RHD patients ($n=10$)	3	2.10 (.994)	1.80 (.632)	1.20 (.632)	1.40 (.843)
LHD patients ($n=9$)	3	3	2.56 (.726)	1.89 (.601)	1.56 (.526)
Controls ($n=10$)	3	3	2.60 (.516)	2.70 (.483)	2.50 (.607)

Standard deviations are in parentheses.

mance, standard communication, non-standard communication). Thus, we obtain $\alpha = 0.017$.

The pragmatic performance of RHD patients considered as a whole is poorer than the performance of the controls (Mann–Whitney test: $z = -3.662$, $p < .0001$). In particular, the two groups perform differently in standard communication (Mann–Whitney test: $z = -3.222$, $p = .001$) and in non-standard communication (Mann–Whitney test: $z = -3.503$, $p < .0001$).

The pragmatic performance of LHD patients considered as a whole is poorer than the performance of the controls (Mann–Whitney test: $z = -2.554$, $p = .011$). The difference is due to the poorer performance of LHD patients for non-standard acts (Mann–Whitney test: $z = -2.936$, $p = .003$), whereas in standard acts, the performance of LHD patients does not differ from that of the controls (Mann–Whitney test: $z = -.096$, $p = .923$). Table 5 and Fig. 2 shows the mean correct performance in the three groups of participants.

Table 5
Mean correct performance by RHD patients, LHD patients and controls for standard, non standard and global performance

	Standard acts	Non-standard acts	Global performance
RHD patients ($n=10$)	6.90 (1.370)	2.60 (.966)	9.50 (1.434)
LHD patients ($n=9$)	8.56 (.726)	3.44 (.882)	12.00 (1.118)
Controls ($n=10$)	8.60 (.516)	5.20 (1.033)	13.8 (1.398)

Standard deviations are in parentheses.

ii. LHD patients versus RHD patients

Results show that RHD patients' performance is globally worse than LHD patients' performance (Mann–Whitney test: $z = -3.149$, $p = .002$). In particular, the two groups perform differently in standard communication (Mann–Whitney test: $z = -2.944$, $p = .003$), but not in non-standard communication (Mann–Whitney test: $z = -1.792$, $p = .073$).

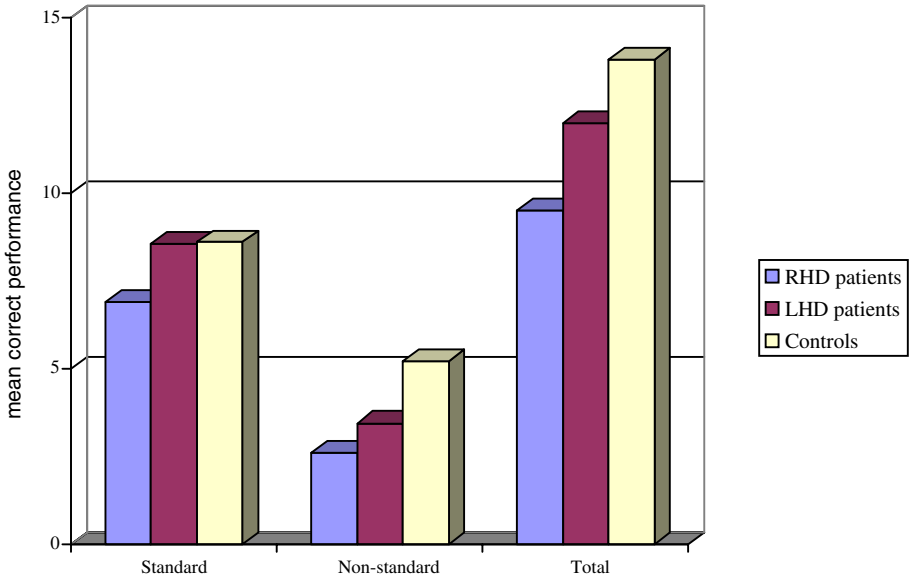

Fig. 2. Mean correct performance by RHD patients, LHD patients and controls.

Comparisons within-groups

iii. Standard communication is easier to comprehend than non-standard communication.

To properly compare standard versus non-standard communication, we took into account the data of all the communication acts of the *simple* sort, that is directs and conventional indirects for standard communication, and ironies and deceit for non-standard communication.

The performance of RHD patients for non-standard communication is significantly worse than their performance for standard communication (Wilcoxon test: $z = -2.809$, $p = .005$). Likewise the performance of LHD patients for non-standard communication is significantly worse than their performance for standard communication (Wilcoxon test: $z = -2.692$, $p = .007$). The same result holds for controls (Wilcoxon test: $z = -2.848$, $p = .004$).

iv. Direct acts are equally difficult to understand as conventional indirect acts.

Results show that both controls and LHD patients performed correctly in 100% of the tasks involving direct and conventional indirect acts; on the contrary the performance of RHD patients for conventional indirect acts is significantly worse than their performance for direct acts (Wilcoxon test: $z = -2.060$, $p = .039$).

v. Simple standard acts are easier to comprehend than complex standard acts.

As regards standard communication, we compared simple versus complex acts. LHD patients performed better with simple than with complex acts (Wilcoxon test: $z = -2.558$, $p = .011$); the same result holds for LHD patients (Wilcoxon test: $z = -2.000$, $p = .023$) and for controls (Wilcoxon test: $z = -2.201$, $p = .028$).

Table 6
Number of "erroneous misleading" answers (E.M.) and "pure erroneous" answers (P.E.) by RHD patients, LHD patients and controls for each pragmatic task

	Controls	RHD patients	LHD patients I
Directs	—	—	—
Conventional	—	E.M. = 4	E.M. = 2
Indirects		P.E. = 5	P.E. = 1
Non-conventional	E.M. = 2	E.M. = 5	E.M. = 4
Indirects	P.E. = 2	P.E. = 7	P.E. = 3
Simple ironies	E.M. = 3	E.M. = 10	E.M. = 9
	P.E. = 2	P.E. = 6	P.E. = 7
Simple deceits	E.M. = 3	E.M. = 6	E.M. = 5
	P.E. = 4	P.E. = 13	P.E. = 8

Finally, we also analyzed the participants' mistakes, dividing them into two categories: the "erroneous misleading" answers (that correspond to the alternative b), and the "pure erroneous" answers (that correspond to the alternatives c and d). Results (reported in Table 6) show that, in the answering phase, participants did not immediately exclude the "pure erroneous" alternatives: indeed, their mistakes are often due to a "pure erroneous" answer.

5. Discussion and conclusions

Our work analyzes the extralinguistic side of pragmatic competence in healthy individuals, RHD and LHD patients. LHD patients have been systematically investigated as regards their language deficits and their linguistic pragmatic impairments, but their extralinguistic pragmatic impairments have seldom been studied.

The main aim of our experiment was to evaluate the kind of deficit, if any, LHD patients show for extralinguistic communication, and to compare RHD and LHD patients' performance on the pragmatic test. A comparison

of performance by the three groups shows that, on the global performance, both patients' groups perform significantly worse than controls; this means that both hemisphere contribute significantly to managing the mental representations and the inferences involved in the comprehension of a communication act.

Nevertheless, there are many differences between the performance by RHD and LHD patients, that suggest a different contribution of the two hemispheres. Indeed for standard communication the LHD group performs better than the RHD group and, furthermore, performs almost as well as controls. Thus, RHD patients show greater difficulty in dealing with even the easiest kind of pragmatic acts. This result adds evidence in favor of the hypothesis that pragmatic ability, even when tested through extralinguistic means, relies more although not exclusively, on the right hemisphere. The same response pattern already observed for the linguistic modality is confirmed for the extralinguistic one.

The poor pragmatic performance of RHD patients is even more evident if considered together with their performance on the Raven test. We submitted both patient groups to the Raven test to obtain a measure of their global cognitive impairment (Section 4). Although it is not statistically significant, there is a slight difference between the performance of the two groups: the RHD group is a little less impaired than the LHD group. Therefore, the worse performance by RHD patients on the pragmatic test is not due to a generally greater level of cognitive impairment. Furthermore, as the Raven test is a typical visual test, the fact that RHD patients perform at least as well as, if not a little better than, LHD patients, enables us to assume that the RHD group was not impaired in their attention to visual stimuli. This consideration is relevant because the pragmatic protocol also involves visual stimuli.

We looked at pragmatic ability through the theoretical framework of the Cognitive Pragmatics Theory, which assumes that two main factors affect the degree of difficulty in comprehending a pragmatic phenomenon either in its linguistic or extralinguistic nature: the sort of mental representations involved (standard versus non-standard) and the inferential load required (simple versus complex).

The results confirm the role of both the factors considered; as regards the presence of conflicting mental representations, both controls and patients perform worse with non-standard communication than with standard communication. This means that when the mental representations involved in the comprehension of a communication act are in conflict (non-standard communication), then the communication act is harder to comprehend with respect to the case in which the mental representations involved in comprehension are not in conflict (standard communication).

The second factor taken into consideration is the inferential load necessary to link the communication act to the behavioral game bid by the actor. We expected to find no difference in the difficulty of understanding direct and conventional indirect acts in that they are both simple standard acts, and they directly refer to the game bid by the actor. This prediction is confirmed for controls and for LHD patients, but not for RHD patients. A tentative explanation is that the difficulty of RHD patients in dealing with conventional indirect acts is mainly due to a loss of their knowledge about conventional social games, with the consequence that their process of understanding a conventional indirect act is much more like their process of understanding a non-conventional indirect act. The results indeed show that performance by RHD patients with conventional indirect acts is more similar to their performance with non-conventional indirect acts than to their performance with direct acts.

Also, according to our expectations, we found that controls, RHD and LHD patients performed worse with complex acts than with simple acts. However, for controls and LHD patients, though not for RHD patients, we detected a ceiling effect in simple standard acts.

The confirmation of both the theoretical assumptions allows us to sketch some conclusions on the difference that emerged between the two patient groups. With respect to the former factor, we found that LHD patients, when compared with controls, preserve their ability to understand the standard communication, whereas RHD patients do not. Thus, a lesion to the LH seems most of all to impair the ability to understand those communicative acts that involve dealing with conflicting mental representations, while the ability to understand those communicative intentions that do not imply a conflict of mental representations is preserved. On the contrary, a lesion to the RH causes a more basic impairment in dealing with mental representations of a communicative intention, regardless of whether or not they are conflicting.

With respect to the second factor, we found that the performance of LHD patients does not differ from that of controls for complex acts, that require a longer inferential chain than simple acts; thus it seems that LHD patients are not impaired in dealing with inferences, even when they are of the complex sort. Indeed, if they had difficulty with long inferences, they would have performed worse than controls for the non-conventional standard acts. On the contrary, as RHD patients perform worse than controls not only for complex standard acts, but also for standard acts of the simple sort, they show impairments in dealing with inferential chains that are either short or long. Thus, for RHD patients only, short inferential chains are already a critical issue; their pragmatic impairment is due, probably in a more substantial way with respect to LHD patients, to a poor inferential capacity. This is consistent with the finding that RHD patients have a deficit in their ability to draw inferences, also when inferences are not drawn in a communicative context (e.g., Beeman, 1998; Joanette et al., 1986; Molloy et al., 1990).

It is possible that our experimental results may be explained by theories other than the Cognitive Pragmatics Theory. We envisage a single alternative to our proposal, that is the Relevance Theory (Sperber & Wilson, 1986), according to which different pragmatic phenomena can be explained by means of a single principle, relevance. The

principle of relevance, which is rooted in human cognition, guides the hearer in understanding the communicative intentions of the speaker. To understand a communication act, the interlocutor has to select a context which will maximize the relevance of the utterance being processed. The inferential machinery which carries out the relevance calculation consists of a deductive device based on a formal logic. However, this approach has not yet given rise to predictions on the relative difficulty in understanding different pragmatic phenomena. A further limit of the theory is that the assumption about the existence of a deductive device based on a formal logic has been questioned by recent studies on deductive reasoning (Bara, Bucciarelli, & Lombardo, 2001; Bucciarelli & Johnson-Laird, 1999; Nicolle, 2003).

In pragmatics literature, there are several other important approaches that, unlike the Cognitive Theory, also focus on social factors involving pragmatic ability. Since they are founded on a different view of pragmatics, there is no common ground on which to compare their assumptions and predictions with the assumptions and predictions of theories grounded on a cognitive view of pragmatics. Furthermore, none of these approaches, in their present form, predicts graded difficulty among communication acts. For instance, the Conversation Analysis approach (Damico, Oelschlaeger, & Simmons-Mackie, 1999; Schegloff, 1989, 1991) focuses on those features of pragmatics which can be accounted for in terms of interpersonal activity; this view is consistent with the framework proposed by Clark (1996), who focuses more on cognitive and linguistic interactions among individuals than within the individual. Recently, Perkins (2002, 2005) sketched a holistic and emergentist approach to both pragmatic ability and disability. Pragmatic functioning is viewed as the emergent consequence of interactions among linguistic, cognitive and sensorimotor processes; thus the investigation is not focused on the entities or the categories that are assumed to compound pragmatic ability, but on the characteristics of their interactions.

A final consideration: several studies reveal that RHD patients are more impaired than LHD patients in theory of mind tasks (for instance, Baron-Cohen et al., 1994; Happé, Brownell, & Winner, 1999; Siegal, Carringhton, & Radel, 1996); this result holds in particular for prefrontal patients (Stuss, Gallupp, & Alexander, 2001). To avoid the risk of participants in our study being heavily impaired in understanding the mental states of others, we presented all of them with a first-order theory of mind test as an entrance test. Nevertheless, this entrance test merely guarantees a minimum level of mentalizing ability, necessary to understand easy communication acts (in our terminology, the standard communication acts). Communication acts such as deceit require instead a second-order theory of mind ability, that we did not assess; thus, it is possible that a deficit at the theory of mind level contributes to the pragmatic impairment of RHD patients. Future research will need to investigate this issue in greater depth, through an evaluation of patients' pragmatic performance that also takes into account differences in patients' possible impairment in solving second-order theory of mind tests.

Acknowledgments

This work was supported by M.I.U.R. of Italy, PRIN project (research code: 2004111320). The authors are grateful to Marco del Giudice for his help with statistical analysis.

Appendix A. The extralinguistic pragmatic protocol

Simple standard acts: Direct acts

Hold me. A child (A) is walking with her mother (B) along the road. A tags onto B's dress and holds her arms up. The alternatives for A's thought are

(a) B picks A up
(b) B washes A's hands
(c) A is carrying a doll
(d) B looks at some plants

The heavy box. A is carrying a heavy box, and he arrives at the front door of his home. A kicks the door with his foot. The alternatives for A's thought are

(a) B opens the door
(b) A goes away with his bag
(c) A and B are hanging pictures
(d) B takes a bicycle

The car door. A boy (A) opens a car door for a girl (B). The alternatives for A's thought are

(a) B gets into the car
(b) A gets into the car
(c) B plays with a doll
(d) A makes a phone call

Simple standard acts: Conventional indirect acts

The window. Two girls (A and B) are in a room. A is reading a book. B opens the window. A catches B's attention and points to the window. The alternatives for A's thought are

(a) B closes the window
(b) B strokes a dog
(c) A and B play Scrabble
(d) A eats an apple

The bottle of water. Two girls (A and B) are sitting at a table. A points to the bottle for B to pass. The alternatives for A's thought are

(a) B passes A the water
(b) B pours himself some water
(c) A eats some chips
(d) A and B play cards

The chair. A is sitting in front of her desk holding a telephone receiver, B comes in. A points to a chair for B to sit down on. The alternatives for A's thought are

(a) A and B are sitting
(b) B is sitting on the floor
(c) A is combing her hair
(d) B is lying on a sofa

Simple deceits

The teacher. In a classroom, children are doing math exercises. One child (A) is holding a book to hide the comic strips inside. The teacher (B) comes over, suspiciously. A hides the comics under the desk and shows the teacher her book. The alternatives for A's thought are

(a) B pats A's head with approval
(b) A is reprimanded
(c) A, C, and D are playing together
(d) A and C are reading a comic

The broken vase. A and C are playing with some pillows. A knocks a vase over. A boy (B) hears the crash and comes in. B looks at them with a questioning look and A points to C. The alternatives for A's thought are

(a) B reprimands C
(b) B reprimands A
(c) A and C test their strength in an arm wrestle
(d) B reads a newspaper

Hide and seek. Two children are playing hide and seek. B counts and C goes to hide behind the door. A third child (A) helps C to hide. C asks A not to reveal his hiding place. B looks at them questioningly and A points under the table. The alternatives for A's thought are

(a) B looks under the table
(b) B looks behind the door
(c) A and C play together
(d) C is counting

Simple Ironies

Lego. Two children A and B are playing with lego. Together they are building a fairly high tower. B knocks the tower over. A claps. The alternatives for A's thought are

(a) A is sad
(b) A is happy
(c) B is drawing
(d) A and B are playing the piano

The sweets. Two girls (A and B) are sitting at a table. B has two sweets, she is eating one of them. A asks if she can have the other one. B eats the second sweet and gives A the paper. A strokes B on the back. The alternatives for A's thought are

(a) A sticks her tongue out at B
(b) A kisses B
(c) A is cooking
(d) A and B are hanging out the laundry

The newspaper. Two boys are sitting in a park. B is eating a snack and A is reading a newspaper. The snack falls on the ground. B picks it up and goes on eating it. A presses his cheek with his finger (Italian version of patting one's stomach). The alternatives for A's thought are

(a) B throws the snack away
(b) B eats the snack
(c) A drinks some water
(d) A and B open a door

Complex standard acts: Non-conventional indirect acts

The empty purse. A child (B) is walking with his sister (A). They stop in front of a toy shop. B points insistently at a game. A shows him her empty purse The alternatives for A's thought are

(a) A and B go away
(b) B has the game in his hands
(c) A laces up B's shoes
(d) A gets a chocolate from the chocolate machine

The hammer. A girl (A) is sitting at a table studying, whilst another girl (B) is hammering. A catches B's attention by pointing to her book. The alternatives for A's thought are

(a) B stops hammering
(b) B hammers
(c) A and B drink some tea
(d) A is drawing

Peeling potatoes. A girl (A) with a boy (B) are peeling potatoes. Another girl (C) arrives carrying a ball. C shows B the ball, A stops B from getting up by holding his arm. The alternatives for A's thought are

(a) B helps A
(b) B and C play with the ball
(c) A washes up
(d) B plays the guitar

References

Airenti, G., Bara, B. G., & Colombetti, M. (1993a). Conversation and behaviour games in the pragmatics of dialogue. *Cognitive Science, 17*, 197–256.

Airenti, G., Bara, B. G., & Colombetti, M. (1993b). Failures, exploitations and deceits in communication. *Journal of Pragmatics, 20*, 303–326.

Bara, B. G. (2005). *Cognitive Pragmatics*. Cambridge, MA: MIT Press.

Bara, B. G., Bosco, F. M., & Bucciarelli, M. (1999). Developmental pragmatics in normal and abnormal children. *Brain and Language, 68*(3), 507–528.

Bara, B. G., Bucciarelli, M., & Geminiani, G. (2000). Development and decay of extralinguistic communication. *Brain and Cognition, 43*, 1–3.

Bara, B., Bucciarelli, M., & Lombardo, V. (2001). Model theory of deduction: A unified computational approach. *Cognitive Science, 25*, 839–901.

Bara, B. G., Cutica, I., & Tirassa, M. (2002). Neuropragmatics: Extralinguistic communication after closed head injury. *Brain and Language, 77*, 72–94.

Bara, B. G., Tirassa, M., & Zettin, M. (1997). Neuropragmatics: neuropsychological constraints on formal theories of dialogue. *Brain and Language, 59*, 7–49.

Baron-Cohen, S., Ring, H., Moriarty, J., Schmitz, B., Costa, D., & Ell, P. (1994). Recognition of mental stat terms: Clinical findings in children with autism and a functional neuroimaging study of normal adults. *British Journal of Psychiatry, 165*, 640–649.

Beeman, M. (1993). Semantic processing in the right hemisphere may contribute to drawing inferences from discourse. *Brain and Language, 44*, 80–120.

Beeman, M. (1998). Coarse semantic coding and discourse comprehension. In M. Beeman & C. Chiarello (Eds.), *Right hemisphere language comprehension: Perspectives from cognitive neuroscience* (pp. 255–284). Mahwah, NJ: Erlbaum.

Beeman, M., Bowden, E., & Gernsbacher, M. A. (2000). Right and left hemisphere cooperation for drawing predictive and coherence inferences during normal story comprehension. *Brain and Language, 71*, 310–336.

Bloom, R., Borod, J., Obler, L., & Koff, E. A. (1990). Preliminary characterization of lexical emotional expression in right and left brain-damaged patients. *International Journal of Neuroscience, 55*, 71–80.

Borod, J. C., Pick, L. H., Andelman, F., Obler, L. K., Welkowitz, J., Rorie, K. D., et al. (2000). Verbal pragmatics following unilateral stroke: Emotional content and valence. *Neuropsychology, 14*, 112–124.

Brownell, H. H., Carroll, J. J., Rehak, A., & Wingfield, A. (1992). The use of pronoun anaphora and speaker mood in the interpretation of conversational utterances by right hemisphere brain-damaged patients. *Brain and Language, 43*, 121–147.

Brownell, H. H., Michelow, D., Powelson, J., & Gardner, H. (1983). Surprise but not coherence: Sensitivity to verbal humor in right-hemisphere patients. *Brain and Language, 18*, 20–27.

Bucciarelli, M., Colle, L., & Bara, B. G. (2003). How children comprehend speech acts and communicative gestures. *Journal of Pragmatics, 35*, 207–241.

Bucciarelli, M., & Johnson-Laird, P. N. (1999). Strategies in syllogistic reasoning. *Cognitive Science, 23*(3), 247–303.

Champagne, M., Virbel, J., Nespolous, J-L., & Joanette, Y. (2003). Impact of right hemispheric damage on a hierarchy of complexity evidenced in young normal subjects. *Brain and Cognition, 52*, 152–157.

Clark, H. H. (1996). *Using language*. New York, NY, US: Cambridge University Press.

Clark, H. H., & Gerrig, R. J. (1984). On the pretense theory of irony. *Journal of Experimental Psychology: General, 113*, 121–126.

Coulson, S., Federmeier, K. D., Van Petten, C., & Kutas, M. (2005). Right hemisphere sensitivity to word- and sentence-level context: Evidence from event-related brain potentials. *Journal of Experimental Psychology: Learning, Memory and Cognition, 31*(1), 129–147.

Cutica, I. (2005). Neuropsychological evidence for linguistic and extralinguistic paths in communication. *Proceedings of the International Conference of Cognitive Science*, Stresa, 21–23 July.

Damico, J. S., Oelschlaeger, M., & Simmons-Mackie, N. (1999). Qualitative methods in aphasia research: Conversation analysis. *Aphasiology, 13*(9–11), 667–679.

Ernest-Baron, C., Brookshire, R., & Nicholas, L. (1987). Story structure and retelling of narratives by aphasics and non-brain damaged patients. In S. Segalowitz (Ed.), *Language functions and brain organization* (pp. 51–86). San Diego, CA: Academic Press.

Faust, M. (1998). Obtaining evidence of language comprehension from sentence priming. In M. Beeman & C. Chiarello (Eds.), *Right hemisphere language comprehension: Perspectives from cognitive neuroscience* (pp. 161–186). Hillsdale, NJ: Erlbaum.

Faust, M., & Gernsbacher, M. (1996). Cerebral mechanism for suppression of inappropriate information during sentence comprehension. *Brain and Language, 53*, 234–259.

Gardner, H., Brownell, H. H., Wapner, W., & Michelow, D. (1983). Missing the point? The role of the right hemisphere in the processing of complex linguistic materials. Cognitive processing in the right hemisphere. In E. Perecman (Ed.), (pp. 37–74). New York: Academic Press.

Grice, P. H. (1975). Logic and conversation. In P. Cole & J. L. Morgan (Eds.), *Syntax and semantics, Vol. 3: Speech acts* (pp. 41–58). New York: Academic Press.

Grice, P. H. (1978). Further notes on logic and conversation. In P. Cole (Ed.), *Syntax and semantics, Vol. 9: Pragmatics* (pp. 113–128). New York: Academic Press.

Happé, F., Brownell, H., & Winner, E. (1999). Acquired "theory of mind" impairment following stroke. *Cognition, 70*, 211–240.

Hellige, J. B. (1983). Hemisphere × task interaction and the study for laterality. In J. B. Hellige (Ed.), *Cerebral hemisphere asymmetry: Method theory and application* (pp. 441–443). New York: Praeger.

Holland, A. (1982). Observing functional communication of aphasic adults. *Journal of Speech and Hearing Disorders, 47*, 50–56.

Hough, M. S. (1990). Narrative comprehension in adults with right and left hemisphere brain-damage: Theme organization. *Brain and Language, 38*, 253–277.

Joanette, Y., & Goulet, P. (1986). Criterion-specific reduction of verbal fluency in right-brain-damaged right-handers. *Neuropsychologia, 24*, 875–879.

Joanette, Y., Goulet, P., Ska, B., & Nespoulous, O. (1986). Informative content of narrative discourse in right brain-damaged right-handers. *Brain and Language, 29*, 81–105.

Kaplan, J. A., Brownell, H. H., Jacobs, J. R., & Gardner, H. (1990). The effects of right hemisphere damage on the pragmatic interpretation of conversational remarks. *Brain and Language, 38*, 315–333.

Kertesz, A. (1982). *Western aphasia battery*. Orlando, FL: Grune & Stratton.

Kumon-Nakamura, S., Glucksberg, S., & Brown, M. (1995). How about another piece of pie: The allusional pretense theory of discourse irony. *Journal of Experimental Psychology: General, 124*(1), 3–21.

McDonald, S. (1996). Clinical insights into pragmatic theory: Frontal lobe deficits and sarcasm. *Brain and language, 68*, 486–506.

Myers, P. S. (1994). Communication disorders associated with right-hemisphere brain damage. In R. Chapey (Ed.), *Language intervention strategies in adult aphasia* (pp. 513–534). Baltimore: Williams & Wilkins.

Molloy, R., Brownell, H. H., & Gardner, H. (1990). Discourse comprehension by right-hemisphere stroke patients: Deficits of prediction and revision. In Y. Joanette & H. Brownell (Eds.), *Discourse ability and brain damage: Theoretical and empirical perspectives* (pp. 113–130). New York: Springer-Verlag Publishing.

Morgan, J. (1990). Comments on Jones and on Perrault. In P. R. Cohen, J. Morgan, & M. E. Pollack (Eds.), *Intentions in communication* (pp. 187–193). Cambridge, Mass: MIT press.

Nicolle, S. (2003). Mental models theory and relevance theory in quantificational reasoning. *Pragmatics and Cognition, 2*, 345–378.

Perkins, M. (2002). An emergentist approach to clinical pragmatics. In F. Windsor, M. L. Kelly, & N. Hewlett (Eds.), *Investigations in clinical phonetics and linguistics* (pp. 1–14). Mahwah, NJ, US: Lawrence Erlbaum Associates, Publishers.

Perkins, M. (2005). Pragmatic ability and disability as emergent phenomena. *Clinical Linguistics and Phonetics, 19*(5), 367–377.

Richards, L., & Chiarello, C. (1997). Activation without selection: Parallel right hemisphere roles in language and intentional movement. *Brain and Language, 57*, 151–178.

Roman, M., Brownell, H. H., Potter, H. H., & Seibold, M. S. (1987). Script knowledge in right hemisphere damaged and in normal elderly adults. *Brain and Language, 31*, 151–170.

Schegloff, E. A. (1989). Reflections on language, development, and the interactional character of talk-in-interaction. Crosscurrents in contemporary psychology. In M. H. Bornstein & J. S. Bruner (Eds.), *Interaction in human development* (pp. 139–153). Hillsdale, NJ, England: Lawrence Erlbaum.

Schegloff, E. A. (1991). Conversation analysis and socially shared cognition. In L. B. Resnick & J. M. Levine (Eds.), *Perspectives on socially shared cognition* (pp. 150–171). Washington, DC, US: American Psychological Association.

Siegal, M., Carringhton, J., & Radel, M. (1996). Theory of mind and pragmatic understanding following right hemisphere damage. *Brain and Language, 53*, 40–50.

Sperber, D., & Wilson, D. (1981). Irony and the use-mention distinction. In P. Cole (Ed.), *Radical pragmatics* (pp. 295–318). New York: Academic Press.

Sperber, D., & Wilson, D. (1986). *Relevance*. Cambridge, Mass: Harvard University Press.

Stemmer, B., Giroux, F., & Joanette, Y. (1994). Production and evaluation of requests by right hemisphere brain damaged individuals. *Brain and Language, 47*, 1–31.

Stuss, D. T., Gallupp, G. G., & Alexander, M. P. (2001). The frontal lobes are necessary for "Theory of mind". *Brain, 124*, 279–286.

Ulatowska, H., Freedman-Stern, R., Doyel, A., Macaluso-Haynes, S., & North, A. (1983). Production of narrative discourse in aphasia. *Brain and Language, 19*, 317–334.

Weylman, S. T., Brownell, H. H., Roman, M., & Gardner, H. (1989). Appreciation of indirect requests by left-and right-brain damaged patients: The effect of verbal context and conventionality of wording. *Brain and Language, 36*, 580–591.

Winner, E., & Gardner, H. (1977). The comprehension of metaphor in brain-damaged patients. *Brain, 100*, 719–727.

Zaidel, E. (1983). Disconnection syndrome as a model for laterality effects in the normal brain. In J. Hellige (Ed.), *Cerebral hemisphere asymmetry: Method, theory and application* (pp. 95–151). New York: Praeger.