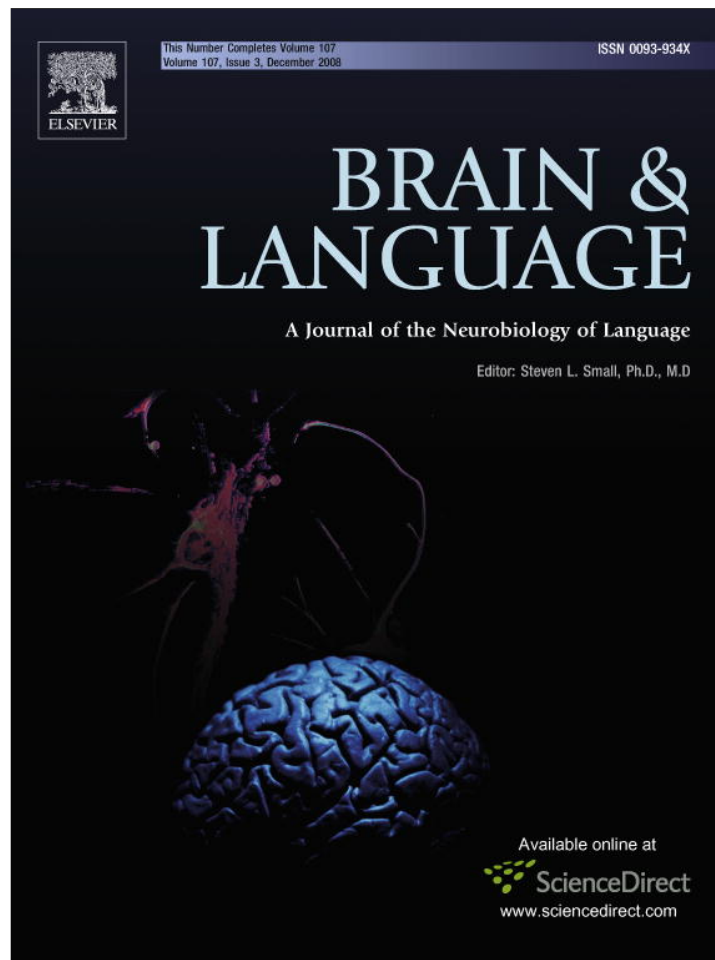


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Communicative impairment in traumatic brain injury: A complete pragmatic assessment

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Accepted 5 January 2008

Available online 11 February 2008

Abstract

The aim of the present study was to examine the communicative abilities of traumatic brain injury patients (TBI). We wish to provide a complete assessment of their communicative ability/disability using a new experimental protocol, the *Assessment Battery of Communication*, (ABaCo) comprising five scales—linguistic, extralinguistic, paralinguistic, context and conversational—which investigate all the main pragmatic elements involved in a communicative exchange. The ABaCo was administered to 21 TBI subjects and to a control group. The results showed that performance by TBI patients was worse than that of controls on all scales; moreover they showed a trend of increasing difficulty in understanding and producing different pragmatic phenomena, i.e., standard communication acts, deceits and ironies, whether such phenomena are expressed through the linguistic or extralinguistic modality.

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Keywords: Communication; Cognitive Pragmatics; Irony; Deceit; Verbal; Non-verbal; Paralinguistic; Inferential process

1. Introduction

Research over the last decades has shown that traumatic brain injury (TBI) patients results in a range of communicative deficits that cannot be adequately explained in terms of linguistic impairment. Patients affected by TBI do not display classical aphasic symptoms: their syntactical and lexical abilities are often normal and their performance on standardized aphasia batteries is good (McDonald, 1993). Nevertheless, they have substantial difficulty managing interactions in their everyday life, since communicative ability involves going

beyond the comprehension and production of correct lexical and syntactical aspects. The literature has dealt with communication in TBI patients, focusing on peculiar pragmatic phenomena, often only considering one specific communicative modality, typically linguistic. In addition, classical pragmatic assessment measures differ along a number of dimensions (Penn, 1999), providing an account of patients' communicative skills but making it difficult to compare the results obtained by different evaluation tools. In this paper, we aim to provide a broad description of the communicative abilities in TBI patients, using a new experimental protocol the *Assessment Battery of Communication—ABaCo* (Sacco et al., submitted for publication). The ABaCo is made up of five different evaluation scales—linguistic, extralinguistic, paralinguistic, context and conversational—which investigate all the principal pragmatic aspects involved in communicative exchanges in order to delineate a complete assessment of the communicative ability/disability in TBI patients.

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1.1. Communicative abilities in TBI

The discourse of TBI patients may be long-winded, poorly organized and tangential (Glosser, 1993; Luria, 1976); by contrast, some patients may have a level of *linguistic* productivity that is lower than normal, not being able to communicate basic needs (Hartley & Levin, 1990). Some patients have confused verbal behavior, inaccurate and confabulating speech (Hartley & Jensen, 1992). From a pragmatic viewpoint, TBI patients encounter difficulties at various levels in comprehension tasks: they cannot go beyond the literal meaning of utterances (e.g., Winner & Gardner, 1977), not being able to understand what is implied, as in the case of comprehension of sarcastic utterances (McDonald, 1992; McDonald & Pearce, 1996), humor (Braun, Lissier, Baribeau, & Ethier, 1989; Docking, Murdoch, & Jordan, 2000) or commercial messages which require inferential processes in order to be understood (Pearce, McDonald, & Coltheart, 1998). TBI patients are also differently impaired in the production of linguistic communication acts; for example, in producing correct requests (McDonald & Van Sommers, 1993) or giving the interlocutor sufficiently detailed information (McDonald, 1993). It is not only the linguistic modality that sustains severe impairments after traumatic brain damage, but also the *extralinguistic* modality, that is the ability to communicate through gestures (Bara, Cutica, & Tirassa, 2001).

During communicative exchanges, people normally match their linguistic and extralinguistic acts with appropriate *paralinguistic* aspects. Several studies have shown that TBI implies impaired paralinguistic processing. Some authors (i.e., Lezak, 1978; Ylvisaker, Szekeres, Henry, Sullivan, & Wheeler, 1987) have suggested that the inability to recognize emotions expressed by other people, both in their voice and in their facial expression, may even be the causal factor for the antisocial behavior and poor social relationships of TBI patients. In fact, after traumatic brain injury it is difficult to understand prosodic aspects in speech (Joannette, Hiram, & Brownell, 1990), especially in those cases in which prosodic elements would help in disambiguating utterances (Marquardt, Rios-Brown, Richburg, Seibert, & Cannito, 2001).

As already mentioned, the social difficulties after traumatic brain injury spread to the management of social interactions, with the inability to resume and carry on normal personal relationships (Brooks, McKinlay, Symington, Beattie, & Campsie, 1987). Some authors have suggested that the communicative inappropriateness of TBI subjects represents the most impressive obstacle to patients' social reintegration (Milton, Prutting, & Binder, 1984), because of the impairments in *social communication* (Dahlberg et al., 2006; McDonald, Flanagan, Rollins, & Kinch, 2003; Turkstra, McDonald, & DePompei, 2001). All these aspects are central in communication because of their role in setting and maintaining social relationships; it appears to be extremely important to assess this in patients affected by TBI since changes in social ability after brain injury represent one of the most destabilizing and invalidating sides

of the condition (Kinsella, Packer, & Olver, 1991; McDonald, Flanagan, Martin, & Saunders, 2004; Ponsford, Olver, & Curran, 1995).

The aim of the present study is to investigate the principle pragmatic abilities in TBI patients, which have usually been researched separately in the literature on the basis of different experimental protocols, using a single tool, namely the *Assessment Battery of Communication—ABaCo*. The ABaCo was created in order to assess the main pragmatic phenomena involved in communication within the inferential domain of the speech act theory (Austin, 1962; Grice, 1975; Searle, 1979) and in particular within the *Cognitive Pragmatics* theory (Airenti, Bara, & Colombetti, 1993a, 1993b; Bara, 2008), summarized below.

2. Cognitive Pragmatics

2.1. Linguistic and extralinguistic communication

Cognitive Pragmatics (Airenti et al., 1993a, Airenti, Bara, & Colombetti, 1993b; Bara, 2008) is a theory focused on the cognitive processes underlying human communication. We will briefly summarize the main theoretical assumptions of the theory; the reader can refer to the cited published papers for further details.

The theoretical assumptions of the Cognitive Pragmatics theory hold for pragmatic phenomena expressed through both *linguistic* and *extralinguistic* means, i.e., gestures (see also Bara & Tirassa, 1999; Bucciarelli, Colle, & Bara, 2003; De Marco, Colle, & Bucciarelli, 2007); considering the cognitive processes involved, there is a substantial equivalence between the two expressive means and this justifies the identical predictions we postulate for the same pragmatic phenomena investigated. For this reason, throughout this paper we prefer to use the term communication act rather than speech act, and the terms actor and partner, instead of the classical speaker and listener.

A further assumption of the theory is that intentional communication requires behavioral cooperation between two people; this means that when two people communicate they are acting on the basis of a plan that is at least partially shared, that is on the basis of a *behavior game* (see Airenti, Bara, & Colombetti, 1984). The role of behavior games is fundamental in a communicative interaction: the meaning of any communication act is fully understood only when the game the move belongs to has been identified.

Within the theoretical framework offered by the Cognitive Pragmatics theory, Bara and Bucciarelli (1998) propose abandoning the distinction between direct and indirect speech acts and adopting the distinction between *simple* and *complex* standard communication acts. The length of the inferential load necessary to connect the communication act to the behavior game shared by the interlocutors is the factor that determines the difference between simple and complex speech acts: a simple communication act immediately makes reference to the behavior game of which it represents a move, whereas a complex

communication act requires more inferential load, and is consequently more difficult to understand. The distinction between simple and complex also applies to the comprehension of deceit and irony.

In terms of the Cognitive Pragmatics theory, a deceit is a premeditated rupture of the rules governing sincerity in the behavior game at play. Some deceitful communication acts are simple because they consist of an utterance that denies something that would allow the partner to immediately refer to the game the actor wishes to conceal. By contrast, a complex deceitful communication act consists of a communication act that implies a belief, which leads the partner to a different game from the one that would be reached if the partner had access to the actor's private belief (see Bosco & Bucciarelli, 2007 and the Appendix A for an example of simple and complex deceit). Thus, the difficulty in comprehending a deceit depends on the length of the inferential load needed to refer the communication act to the game bid by the actor; for this reason we consider complex deceits more difficult to understand than simple ones.

The Cognitive Pragmatics theory claims that irony can be understood when compared with the scenario provided by the knowledge the actor shares with the partner. The background of knowledge that the partner shares with the actor allows the partner to comprehend the ironic meaning of the utterance. In simple irony, the meaning of the utterance immediately contrasts with the background knowledge shared by the actor and the partner; in complex irony, the detection of such contrast requires a series of inferences. In the comprehension of complex ironies the partner has always to go through a harder inferential load to detect the contrast between utterance and shared background knowledge (see Bosco & Bucciarelli, 2007 and the Appendix A for an example of simple and complex irony).

Bara, Tirassa, and Zettin (1997) found that closed head-injured patients find it easier to comprehend standard simple rather than complex standard communication acts. However, Channon, Pellijeff, and Rule (2005) did not find any difference in closed head-injured patients' ability to comprehend direct and indirect forms of irony, where direct/indirect is for them similar to our simple/complex distinction. However, to our knowledge, most studies investigate deceit and irony comprehension without distinguishing between these two different levels of complexity.

We thus wish to investigate whether the distinction between simple and complex communication acts is a useful category for discriminating different degrees of TBI patients' ability to comprehend linguistic and extralinguistic standard, ironic and deceitful communication acts. In particular, we hypothesize that:

In both linguistic and extralinguistic communication, on the basis of the inferential load involved, we expect that TBI patients find it easier to comprehend a simple communication act than a complex one, within each category—standard, irony and deceit.

In standard communication, default rules of inference govern the comprehension of a communication act (cf.

Reiter, 1980) and what the actor says is in line with his private beliefs. In terms of mental representations, to comprehend a standard communication act the partner has merely to refer the communication act proffered by the actor to the behavior game shared with him. By contrast, non-standard communication involves comprehension and production of communication acts via the block of default rules and the occurrence of more complex inferential processes (see Bucciarelli et al., 2003). In particular, in deceit the actor's communicative intention is in conflict with his private mental states but it does not contrast with the knowledge he gives as shared with the partner. In case of deceit comprehension, the partner recognizes the difference between the mental states that are expressed and those the actor privately entertains. In addition, in irony the actor's communicative intention also contrasts with the knowledge he gives as shared with the partner. This makes an ironic communication act more difficult to entertain than a deceitful one.

The increasing trend of difficulty in the comprehension of standard, deceitful and ironic communication acts has been experimentally validated in studies on children (Bosco et al., 2004; Bucciarelli et al., 2003).

In the present study we wish to extend this theoretical explanation to the *production* of standard, deceitful and ironic communication acts, and empirically investigate it in the TBI population.

These different pragmatic phenomena have been investigated in the TBI population in a series of studies, which reveal difficulties in comprehending sarcasm (Docking, Jordan, & Murdoch, 1999; McDonald & Pearce, 1996) and ironic criticism (Dennis, Lazenby, & Lockyer, 2001) in adults with TBI, and impaired understanding of deceptive praise in children with head injury (Dennis, Purvis, Barnes, Wilkinson, & Winner, 2001). However, no systematic studies have compared the comprehension of standard and non-standard communication acts, and there is virtually nothing about their production. Thus, we hypothesize that:

In both linguistic and extralinguistic communication there is a trend of difficulty in the comprehension and production of different kinds of pragmatic phenomena, from the simplest to the most complex: standard, deceitful and ironic communication acts.

2.1.1. Basic speech acts

Within the set of simple standard communication acts we decided to investigate a specific subset of utterances, basic speech acts (BSAs, Kasher, 1991). BSAs are very basic and prototypical types of speech acts, generally performed by uttering a specific kind of sentence which is linguistically marked as appropriate for it. Examples are assertions, questions, requests and directives. According to Kasher, assertions, which simply express a speaker's belief, are the most elementary type of BSA.

In the present study we wish to extend this distinction to communication acts expressed by extralinguistic and paralinguistic means (see Section 3.2). In addition, to our knowledge, Kasher's prediction regarding the fact that

assertions are easier to understand has never been investigated in TBI patients. Thus, we hypothesize that:

Assertions, expressed through linguistic and extralinguistic means, are the simplest type of BSA to understand and produce.

2.2. Paralinguistic communication

Paralinguistic cues, for example tone, intonation, rhythm and prosody, contribute to generate the pragmatic meaning of a communication act. Such elements have no autonomous status but are tributary aspects of language (Krauss, 1998; Krauss, Morrel-Samuels, & Colasante, 1991).

In line with the Cognitive Pragmatics theory (Bara, 2008) we consider the paralinguistic aspects of communication as a connotative dimension, integrating all aspects, verbal and non-verbal, that are not included in the linguistic and extralinguistic domains, but accompany and integrate the expressed meaning of a communication act. We thus consider all communicative elements highlighting, emphasizing and even modifying the meaning of communication acts as falling within the paralinguistic dimension.

The paralinguistic components can be used to express both an actor's propositional attitude and his emotional state.

To empirically investigate the paralinguistic dimension, in our battery we distinguished two different uses of paralinguistic components: paralinguistic utterances and paralinguistic emotions. The first category refers to items in which paralinguistic cues indicate the actor's propositional attitude versus the relation between the speaker and the proffered utterance (see Russell, 1914) regarding basic communication acts, namely assertions, questions, requests and commands. The second category refers to items in which paralinguistic components transmit emotional states such as anger, fear, happiness and sadness. The literature focused on patients with TBI has primarily investigated the recognition of emotional expressions, reporting an impaired recognition of facial expression (Braun et al., 1989; Croker & McDonald, 2005), whereas Jackson and Moffat (1987) have shown that the recognition deficit also includes the recognition of emotions from body postures. Few studies have reported pervasive deficits in recognition of emotional prosody (Hornak, Rolls, & Wade, 1996; Milders, Fuchs, & Crawford, 2003). No studies in TBI patients investigated paralinguistic cues separately from the emotional content; for this reason we extend our investigation to the paralinguistic components that also accompany propositional contents, hypothesizing in both cases poorer performance among TBI patients compared with normal controls.

Moreover, based on the literature showing that human beings have an innate capacity to recognize and produce some basic emotions which appear long before any other form of language (Ekman & Oster, 1979), we hypothesize that:

Recognition and production of emotional paralinguistic aspects is easier than recognition and production of paralinguistic aspects referring to a propositional attitude.

Paralinguistic aspects are usually in line with the expressed meaning proffered by the actor. However, such indicators may sometimes contrast with the linguistic and extralinguistic content expressed by the actor; for example a person could say "What a nice present" with a puzzled tone and attitude. In such cases we witness an example of paralinguistic contradiction in which paralinguistic cues reveal different mental states compared to the expressed semantic content. Since the integration of contrasting information arriving from different expressive means requires coherence ability, which is deficient in TBI patients (Marquardt et al., 2001), we hypothesize that:

Patients perform worse compared to healthy controls in the recognition of paralinguistic incongruence.

2.3. Social and contextual appropriateness

The notion of cooperation is central in Cognitive Pragmatics, because communication requires at least some measure of cooperation between the interlocutors. The participants in a communicative exchange have to implicitly follow a range of well-established communication norms, implying compliance with the Cooperative Principle (Grice, 1975). During a conversation the interlocutors try to be clear and avoid confusion, to give a truthful contribution, such as is required, at the stage at which it is requested by the accepted purpose or direction of the talk exchange. However, as Grice himself suggests, during natural conversation people often erroneously and unconsciously violate the Cooperative Principle, as happens, for example, to a logorrheic person or a person expressing him/herself in a cryptic manner.

TBI patients often produce long-winded and tangential discourses during their conversation (Glosser, 1993; Hartley & Jensen, 1992), unwarrantedly violating the Cooperative Principle. Thus,

We hypothesize that TBI patients perform worse, compared to healthy controls, in recognizing violation of the Cooperative Principle, during a conversational exchange.

In addition to the norms governing a well-performed conversation, other norms related to politeness and the social status of the participants in the communicative exchange also exist. Politeness is usually conceived as a strategic means to avoid embarrassing situations during social interactions (Brown & Levinson, 1987; Fraser & Nolen, 1981). In particular, Lakoff (1973) proposes some politeness rules to combine with the Cooperative Principle, such as "don't impose", "give options" and "make the other person feel good—be friendly". Politeness rules give rise to the production of indirect speech acts that are usually learned in an implicit way within a specific cultural community. In particular there are a range of collective norms, defined and accepted within a specific culture and determining the social appropriateness of a specific communicative exchange. Such norms refer to *when*, *how* and *what* a person is allowed to say, in relation to the social status, the hierarchical position of the interlocutors and the formality versus informality of the

context. Such aspects of politeness usually refer to a context in which the interlocutor is requested to follow a specific production format, for example (in Italian) use of the third versus first person, the possibility of using versus not using colloquial expressions and so on.

In the present study we wish to assess TBI patients' ability to recognize the violation of social and politeness norms and produce speech acts according to the social context. This is particularly interesting since changes in social behavior have been reported as one of the most common and serious consequences of TBI, manifested in the form of insensitivity, poor social judgment, inappropriate intimacy and disclosure (Crosson, 1987; McDonald, 1992). These aspects have to be carefully evaluated, because of their role in the difficulty of social reintegration post-injury. In more detail, we expect that:

Patients perform worse compared to healthy controls in both comprehension and production of context and social appropriateness tasks.

We will also evaluate whether TBI patients are more sensitive to the violation of social rather than cooperative norms.

Finally, we will compare TBI performance in the production of appropriate communication acts both in formal and informal contexts, hypothesizing that producing an adequate communication act is more difficult in a formal context than in an informal one.

2.4. Conversational aspects

The different communicative abilities delineated in the previous paragraphs are usually integrated within an ecological conversation, in which the agents coordinate their reciprocal participation. According to the Cognitive Pragmatics theory natural dialogues are governed by a *global structure* and a *local structure*. The global structure determines the flow of conversation and the local structure determines the specific sequence of each participant's communicative exchanges.

From the more detailed perspective of the local structure, a dialogue may be considered as consisting of an alternation of *turns*, each of which is a sequence of speech acts uttered by the same actor. *Turn-taking*, which has been studied in depth by Sacks, Schegloff, and Jefferson (1978), is part of the local structure. The local structure also manages the relationship between speech acts within the same turn.

The Cognitive Pragmatics theory views the global structure of dialogues as deriving from the shared knowledge of an action plan, i.e., the behavior game that governs the interaction as a whole. The global structure determines the flow of conversation, in particular, the way in which the different phases of the conversation are pragmatically connected, where a sequence is a block of exchanges tied together by strong semantic coherence. Thus, the primary ability related to this level is *topic management*, which is compliance with discourse topics. On the other hand, the local structure regards the alternation of turns, each of which is a sequence of speech acts uttered by the same

actor, and also manages the relationship between speech acts within the same turn. At this level the primary ability is thus *turn-taking*.

Numerous studies have investigated the conversational abilities of TBI patients, examining phenomena such as topic initiation and response appropriateness (Coelho, Liles, Duffy, & Clarkson, 1992), turn-taking (Coelho, Youse, & Le, 2002), and topic management (Mentis & Prutting, 1991). All these studies have indicated that TBI patients have difficulties with topic management, turn-taking and coherence. In the conversational scale of our battery, we wish to assesses TBI patients' ability to deal with topic management and turn-taking; in particular:

We expect patients to perform worse compared to healthy controls on both tasks.

3. Method

3.1. Participants

Two groups participated in the present study: a TBI group and a normal control group. The TBI group consisted of 21 TBI patients (five female/sixteen male) ranging in age from 20 to 68 years ($M = 36.9$, $SD = 12.5$); their education ranged from 5 to 18 years of schooling ($M = 10.9$, $SD = 3.3$). The TBI patients were recruited through three different centers for rehabilitation following head injury in Geneva and in Turin. The time after onset ranged from 3 to 252 months ($M = 59.5$, $SD = 69.8$). All patients had sustained their injury in a road traffic accident; in particular, 18 in a car crash, 2 in a motorcycle accident and 1 in a bicycle accident all resulting in a closed head injury. Table 1 presents the patients' clinical details. At the time of the study, all patients were living at home; all patients were in a post-acute phase and none of them lived independently without partners or parents.

Patients were selected to participate in the study: inclusion criteria were that the TBI patients must (1) be at least 18 years of age; (2) be at least 3 months post-brain injury; (3) be Italian native speakers; (4) provide informed consent; and finally (5) have adequate cognitive and communication skills, tested by the achievement of a cut-off score in the following neuropsychological tests: MiniMental State Examination (MMSE, Folstein, Folstein, & McHugh, 1975; cut-off: 24/30); denomination scale of the Aachener Aphasia Test (AAT, Huber, Poeck, K, Weniger, & Willmes, 1983; cut-off: no deficit) and Token Test (De Renzi & Vignolo, 1962; cut-off: 5/6). Exclusion criteria were prior history of TBI or other neurological disease, neuropsychiatric illness or communication problems, pre-morbid alcohol or drug addiction.

The control group consists of 33 healthy participants, closely matched to the patients in terms of gender, age (T test: $t = .44$; $p = .66$) and years of education (T test: $t = .09$; $p = .93$). None of them had other brain damage or a history of neurological disorders.

Table 1
Patients' clinical and demographic description

Case	Gender	Age	Education (years)	Site of lesion	Post-injury (months)
T1	M	33	13	Right fronto-parietal	138
T2	M	37	8	Right fronto-temporal	46
T3	F	26	18	Right fronto-parieto-temporal	30
T4	M	45	13	Bilateral fronto-parietal	74
T5	M	21	8	Bilateral fronto-temporo-parietal	32
T6	M	49	11	Right fronto-temporo-parietal	64
T7	M	20	8	Frontal—Diffuse injury	41
T8	M	36	10	Right parieto-temporal	252
T9	M	27	8	Left frontal	35
T10	M	32	13	Right fronto-temporo-parietal	51
T11	M	32	11	Left temporal—Bilateral parietal	23
T12	F	23	13	Bilateral fronto-temporal	19
T13	M	31	11	Left frontal	120
T14	M	68	5	Right fronto-temporal	3
T15	M	59	11	Left fronto-parietal	7
T16	F	37	8	Right fronto-parieto-temporal	15
T17	F	42	13	Right fronto-temporal	18
T18	M	54	18	Left fronto-temporal	48
T19	F	35	8	Bilateral frontal	228
T20	M	29	13	Right fronto-temporal	3
T21	M	39	8	Bilateral frontal	3

3.2. Material

The Assessment Battery of Communication (ABaCo) consists of five different evaluation scales: (1) linguistic scale, (2) extralinguistic scale, (3) paralinguistic scale, (4) context scale, and (5) conversational scale. The whole protocol comprises 180 items: 72 items are based on the examiner's prompts and the remaining 108 items on videotaped scenes. Each videotaped scene lasts 20–25 s and comprises a controlled number of words (range: 7 ± 2). Each scale includes both comprehension and production tasks. Some examples of tasks are reported in [Appendix A](#).

A previous research revealed that ABaCo has a good construct validity, high inter-rater agreement and a good internal consistency of the scales ([Sacco et al., submitted for publication](#)).

We summarize the most salient characteristics of each scale in the following sections.

3.2.1. Linguistic and extralinguistic scales¹

The linguistic scale assesses the comprehension and production of communication acts expressed primarily through linguistic means. The extralinguistic scale also assesses the comprehension and production of communication acts, but only expressed through extralinguistic means. It includes the same communication acts included in the linguistic scale. For this reason, the tasks used in these first two scales are described together.

¹ The linguistic scale is actually an *ecological* scale, because it extends beyond language and also encompasses extralinguistic and paralinguistic elements. However, the linguistic modality is here the primary source of information. Thus, for the sake of simplification, we decided to call it the linguistic scale.

We used the following tasks to assess the comprehension of linguistic and extralinguistic communication acts:

- *Basic communication acts* (assertions, questions, requests and commands): on the linguistic scale, the examiner asks the subject to evaluate the truthfulness of assertions, to answer easy questions, to perform actions on request, to execute orders. On the extralinguistic scale, the examiner shows the subject short videos where an actor makes an assertion, asks a question, makes a request or issues a command through the use of gestures. The subject has to understand the communication acts produced by the actor.
- *Standard and non-standard communication acts* (simple and complex: standard, deceit and irony): the examiner shows the subject short videos where two agents are engaged in a communicative interaction: the actor asks his partner a question and the partner replies. The subject has to understand the communication act produced by the partner. On the linguistic scale the actors communicate verbally, whereas on the extralinguistic scale they communicate through gestures alone.

We used the following tasks to assess the production of linguistic and extralinguistic communication acts:

- *Basic communication acts*: the examiner invites the subject to produce assertions, questions, requests and commands; the examiner provides the semantic content of the requested act (i.e., the examiner says: "Tell me that you are cold" or "Order me to be quiet"). On the linguistic scale the subject has to produce linguistic acts, whereas on the extralinguistic scale the subject can only communicate through gestures.

- *Standard and non-standard communication acts*: the examiner shows the subject short videos where two agents are engaged in a communicative interaction: the actor says something to the partner, the video stops and the subject is requested to assume the partner's perspective in answering the actor. On the linguistic scale the communicative interaction occurs in the linguistic modality and the subject has to reply verbally. On the extralinguistic scale the actor performs communicative gestures without any language support and the subject has to reply using gestures alone.

3.2.2. Paralinguistic scale

The paralinguistic scale assesses the comprehension and production of those aspects that generally accompany a communication act, such as proxemics and prosody. The paralinguistic scale comprises:

- *Basic communication acts* (assertions, questions, requests and commands).
- *Basic emotions* (anger, sadness, happiness and fear).
- Acts characterized by a *paralinguistic contradiction* (assessed only in comprehension).

We used the following tasks to assess the comprehension of paralinguistic aspects:

- *Basic communication acts*: the examiner shows the subject short videos where an actor, speaking an invented language, makes an assertion, asks a question, makes a request or gives a command. The subject has to understand the type of act produced by the actor, by means of paralinguistic indicators. The examiner provides four possible answers, only one of which is correct. For example, the actor in the scene gives a command and the subject is requested to choose from among the following alternatives: "The actor wants: (1) to make a request, (2) to say something that he believes true, (3) to make a command, (4) to joke".
- *Basic emotions*: the examiner shows the subject short videos where an actor, speaking an invented language, expresses a basic emotion. The subject has to recognize the emotion, by means of paralinguistic indicators. The examiner provides four possible answers, only one of which is correct. For example, the actor expresses anger using paralinguistic elements and the subject is requested to choose the correct answer from among the following: "In your opinion, how does the actor feel? (1) sad, (2) angry, (3) happy, (4) scared".
- *Paralinguistic contradiction*: the examiner shows the subject short videos in which two agents are engaged in a communicative interaction: the actor verbally expresses something that is in contrast with the paralinguistic indicators (i.e., the actor says "I like that very much!" while his voice and attitude reveal that he does not like it at all). The subject has to grasp this contradiction, detectable by means of paralinguistic indicators.

We used the following tasks to assess the production of paralinguistic aspects:

- *Basic communication acts*: the examiner asks the subject to produce assertions, questions, requests and commands, paying special attention to the paralinguistic indicators. For example, the examiner tells the subject to "Ask me whether it is sunny today" or "Tell me that it is sunny today".
- *Basic emotions*: the examiner asks the subject to produce communication acts colored by a specific emotion or mood; the examiner provides the semantic content of the requested act and the emotion with which it has to be expressed. For example, the examiner asks the subject to "Tell me that you have received a letter. Tell me that in a happy way".

3.2.3. Context scale

The context scale assesses:

- The adequacy/inadequacy of a communication act with respect to Grice's Maxims (assessed only in comprehension).
- The adequacy/inadequacy of a communication act with respect to *social norms*: the ability to recognize whether and why a communication act is appropriate with respect to a given context or situation (comprehension); the ability to produce communication acts which are appropriate in a given context or situation, according to rules of formality and informality (production).

We used the following tasks to assess the comprehension of discourse and social norms:

- *Grice's Maxims*: the examiner shows the subject short videos where two agents are engaged in a communicative interaction; the actor asks his partner a question; the partner replies either according to or violating the norms of discourse, giving a generic, false, irrelevant or ambiguous answer. The subject has to detect and explain the adequacy/inadequacy of the partner's reply. For example, in an item representing inadequacy with respect to the Gricean Maxim of quantity, the actor asks, "Where are you going precisely?" and the partner replies "I'm going out".
- *Social norms*: the examiner shows the subject short videos where two agents are engaged in a communicative interaction; the actor asks his partner a question; the partner replies either according to the norms of social appropriateness or in a manner which is not appropriate in the given social context. For example, the actor asks "Could you lend me your pen?" and the partner replies in a very impolite way "I don't want to be disturbed!"

We used the following tasks to assess production:

- *Social norms*: the examiner asks the subject to produce communication acts requiring different levels of formality/informality; the examiner provides the semantic content of the requested act.

3.2.4. Conversational scale

This last scale assesses the ability to participate appropriately in a conversation, complying with the topics of the discourse and turn-taking. The examiner and subject are engaged in four short conversations, where the examiner introduces four different topics, for a total duration of 4–6 min each. The examiner and subject engaged in four short conversations, where the examiner introduced four different topics, for a total duration of 4–6 min each. The four topics were the same for each subject: free-time activities, favorite television show, memories of the last holiday and talking about his/her home-town or city. We evaluated the following separately:

- *Topic elements*: we analyzed subjects' conversations looking at (1) topic maintenance, (2) new topic introduction, and (3) change in topic.
- *Turn-taking*: we analyzed subjects' conversations evaluating turn-taking management; in particular, (1) taking turns and (2) respecting the partner's turn during exchanges with the examiner.

3.3. Procedure

All tests were administered individually to the subjects, during two subsequent sessions lasting about one hour each. Patients with TBI were tested at their rehabilitation centers, while normal controls were tested in their homes.

3.3.1. Scoring

The experimental sessions were video-recorded. Subjects' performance was coded off-line from the videotape by two independent judges, blind with respect to the aims of the research and identity of participants (patient versus control). Scoring was kept on specific score sheets by the two, while watching the subjects' video-recorded experimental session. For each task it was possible to obtain 0 or 1 point, on the basis of correct (1 point) or incorrect (0 point) subjects' answer.

In the linguistic and extralinguistic scales, the subject obtains 1 point in the comprehension of *standard communication* acts if he has recognized what the actor expressed and if he has understood what the utterance/gesture implies or presupposes. In the production of standard communication acts, the subject obtains 1 mark if he has produced a communication act, which is congruent with respect to the question. In the linguistic scale the act produced must be an utterance, whereas in the extralinguistic scale a gesture.

In the linguistic and extralinguistic scale, the subject obtains 1 point in the comprehension of a *non-standard communication act* if he has understood not only that the

actor said something "untrue" in order to lie (in the case of deceit) or in order to joke (in the case of irony). Also in the case of non-standard communication, in the linguistic scale the act produced must be an utterance, whereas in the extralinguistic scale a gesture.

The subject obtains 1 point in the production of non-standard communication acts—both in the linguistic and extralinguistic scale—if he produces a plausible act, fulfilling the requested goals. In the case of deceit, the subject has to say (or, in the extralinguistic scale, to communicate with a gesture) something that is not true with the purpose of deceiving. In the case of irony, the subject has to say (or to communicate with a gesture) something fun with the aim of joking.

In the paralinguistic scale, the subject obtains 1 point in the comprehension of *basic communication acts* if he has understood the type of communicated act and 1 point in the comprehension of basic emotions if he has understood the correct emotion expressed. In the production of both basic communication acts and *basic emotions*, the subject gets 1 mark if he produces a communication act with appropriate paralinguistic indicators; in more detail, prosody, kinetics and proxemics must be adequate with respect to the type of communicated basic act or emotion.

In the context scale, in the comprehension of both *Grice's Maxims* and *social norms*, the subject obtains 1 point if he has recognized that there is something inadequate in the proposed communicative exchange. In particular, in the items focused on social norms, the subject has to understand that the communication act is inappropriate as regards to the context/situation, for example mentioning some elements of impoliteness. In the items focused on *Grice's Maxims* violation, the subject has to understand that the inadequacy is referred to the rules underlying good communicative exchanges, which are violated when the content is too generic, false, irrelevant, or ambiguous.

In the production of adequate communication acts to the social norms, the subject gets 1 mark if he produced a communication act appropriate to the context or the situation, with respect to the formality or informality required.

Finally, in the conversational scale, we evaluate five different aspects: the subject obtains 1 point in the *topic maintenance* if he respects the topic proposed by the examiner during brief conversations; 1 point in the *topic introduction/initiation* if he introduced new themes in order to widening conversation; 1 point in the *topic shift* if he followed the different topics of conversation without perseverations. The last two marks are concerning with the *turn-taking* management; in particular, the subject gets 1 point if he intervened in the silent pauses left by the examiner and he did not impose on the examiner's voice; the subject obtains 1 point if he allowed to the examiner time to speak.

The level of agreement among raters assigned by the two independent judges was calculated using the Intraclass Correlation Coefficient (ICC), which provided a generalized measure of inter-rater concordance adjusted for chance agreement between measurements. The ICC for

our scores was .87, indicating high inter-rater agreement. Indeed, Altman (1991) indicates values of >.80 as almost perfect agreement.

4. Results

4.1. Overview

In order to make a survey of our results, we summarize the TBI patients' and the controls' scores in Table 2. TBI group performed worse than control group in all of ABaCo scales, with the exception of the conversational scale. In more detail, in the linguistic scale both comprehension (*T* test: $t = 5.73$; $p < .0001$) and production tasks (*T* test: $t = 4.54$; $p < .0001$), in the extralinguistic scale both comprehension (*T* test: $t = 5.45$; $p < .0001$) and production task (*T* test: $t = 4.55$; $p < .0001$), in the paralinguistic scale both comprehension (*T* test: $t = 5.33$; $p < .0001$) and production (*T* test: $t = 3.7$; $p = .001$), and finally in the context scale, both comprehension (*T* test: $t = 2.56$; $p = .01$) and production (*T* test: $t = 3.2$; $p = .001$). In the conversational scale, the difference between patients and controls was not significant at statistical level (*T* test: $t = 1.07$; $p = .3$).

We report in more detail our results, separately for each assessment scale, in the following sections.

4.2. Linguistic and extralinguistic scale

4.2.1. Simple and complex: standard, deceit and irony

We conducted ANOVA analysis in order to investigate whether TBI patients perform worse than control subjects

and assess TBI patients' performance in the different pragmatic phenomena.

To investigate patients' performance in comprehension of standard, deceitful and ironic communication acts, we conducted ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and two within-subjects factors (*type of phenomenon*, with three levels: standard, deceit and irony; *type of inference*, with two levels: simple and complex). The same analysis was conducted for both the linguistic and extralinguistic comprehension scales. On the linguistic scale, this analysis revealed a main effect of the type of subject ($F_{(1,51)} = 13.04$; $p = .001$; $\eta^2 = .2$). Overall, TBI patients performed significantly worse than control subjects in linguistic comprehension tasks (see Fig. 1). In both the TBI group and control group, there was a main effect of the type of pragmatic phenomenon ($F_{(2,102)} = 7.89$; $p = .001$; $\eta^2 = .13$). We introduced a linear contrast which revealed a linear decrease in scores depending on the type of pragmatic phenomenon ($F = 13.69$, $p = .001$; $\eta^2 = .21$): standard communication acts were the easiest to understand, followed by deceit and finally by irony, the most difficult task (see Fig. 1). There was no main effect of type of inference (simple or complex), ($F_{(1,51)} = .0001$; $p = .99$). There were no significant interactions between factors. As for the Linguistic scale so too for the extralinguistic scale the ANOVA analysis revealed a main effect of the type of subject ($F_{(1,52)} = 9.1$; $p = .004$; $\eta^2 = .15$): TBI patients also performed significantly worse than controls on the extralinguistic comprehension scale. Again there was a main effect of the type of pragmatic phenomenon ($F_{(2,104)} = 31.32$; $p = .0001$; $\eta^2 = .38$) both in the TBI group and in the control group. Also in this case, there was a linear decrease in scores depending on the type of pragmatic phenomenon ($F = 67.4$, $p = .0001$; $\eta^2 = .56$): standard communication acts were the easiest, followed by deceit and finally by irony, the most difficult task (see Fig. 1). There was no main effect of type of inference ($F_{(1,52)} = 1.64$; $p = .21$; $\eta^2 = .03$).

For the production of standard, deceitful and ironic communication acts, we conducted an ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and one within-subjects factor (*type of phenomenon*, with three levels: standard, deceit and

Table 2
Mean and standard deviations (in parentheses) of the scores in the five assessment scales, both comprehension and production tasks

	Comprehension		Production	
	TBI	Controls	TBI	Controls
Linguistic scale	.87 (.11)	.98 (.03)	.79 (.14)	.93 (.08)
Extralinguistic scale	.77 (.19)	.95 (.04)	.75 (.18)	.91 (.09)
Paralinguistic scale	.71 (.11)	.86 (.09)	.83 (.22)	.97 (.04)
Context scale	.82 (.16)	.92 (.11)	.87 (.19)	.95 (.12)
Conversational scale	.88 (.11)	.91 (.1)		

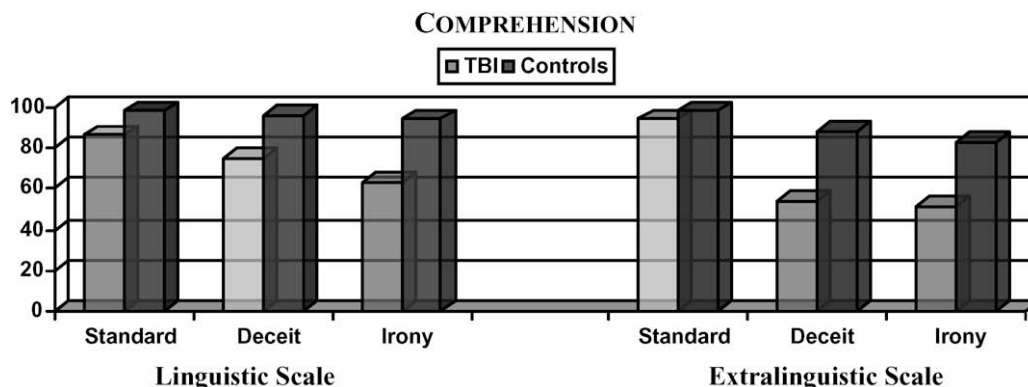


Fig. 1. Comparison between TBI patients and control subjects on comprehension tasks, both in linguistic and extralinguistic scale.

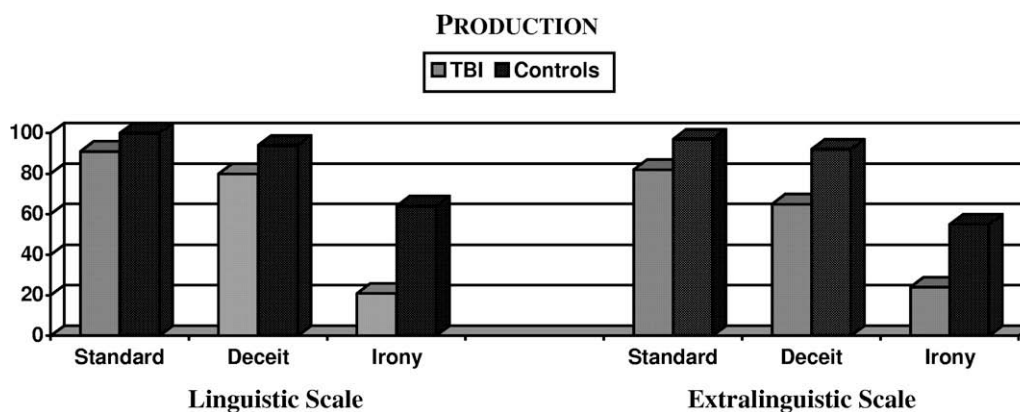


Fig. 2. Comparison between TBI patients and control subjects on production tasks, both in linguistic and extralinguistic scale.

irony). The same analysis was conducted for both the linguistic and extralinguistic production scales. On the linguistic scale, the ANOVA analysis revealed a main effect of the type of subject ($F_{(1,52)} = 35.67$; $p = .0001$; $\eta^2 = .41$): overall, as for comprehension, TBI patients also performed significantly worse than controls on the linguistic production scale (see Fig. 2). There was a main effect of the type of pragmatic phenomenon ($F_{(2,104)} = 95.14$; $p = .0001$; $\eta^2 = .65$), in both the TBI group and in the control group. Linear contrast revealed a linear decrease in scores depending on the type of pragmatic phenomenon ($F = 141.21$, $p = .0001$; $\eta^2 = .73$): standard communication acts were the easiest, followed by deceit and irony, the most difficult phenomenon to produce (see Fig. 2).

On the extralinguistic scale, there was a main effect of the type of subject ($F_{(1,52)} = 24.71$; $p = .0001$; $\eta^2 = .32$): overall, TBI patients performed significantly worse than controls on the extralinguistic production scale (see Fig. 2). There was a main effect of the type of pragmatic phenomenon ($F_{(2,104)} = 71.84$; $p = .0001$; $\eta^2 = .58$), in both the TBI group and in the control group. Again linear contrast revealed a linear decrease in scores depending on the type of pragmatic phenomenon ($F = 103.52$, $p = .0001$; $\eta^2 = .67$): standard communication acts were the easiest, followed by deceit and irony, the most difficult phenomenon to produce (see Fig. 2). There were no significant interactions between factors, neither on the linguistic nor on the extralinguistic production scale.

4.2.2. Basic speech acts

In order to verify whether the assertion represents the easiest kind of BSA in terms of both comprehension and production on the linguistic and extralinguistic scales, we conducted a *T* test analysis between the different kinds of BSAs (see Fig. 3). Surprisingly, as regards linguistic comprehension, the assertion is the BSA that is most difficult to understand (93% of correct responses) compared with questions, requests and commands (95–99%), whereas these differences were not significant at statistical level (*T* test: $.7 < t < 2.02$; $.06 < p < .5$). As regards linguistic production, assertions (95% of correct responses) are the easiest BSA to be produced compared with questions (87%),

requests (89%) and commands (88%), but also in this case the differences were not significant (*T* test: $1.22 < t < 1.37$; $.18 < p < .23$). As for extralinguistic comprehension, assertions (95% of correct responses) are the easiest BSA to understand compared with questions (76%), requests (82%) and commands (86%); the difference was significant in the case of both questions and requests (*T* test: $2.4 < t < 2.9$; $.008 < p < .025$). Finally, for extralinguistic production, assertions were correctly produced in 90% of cases, questions, requests and commands ranged from 84% to 90%; there were no significant differences (*T* test: $.14 < t < 1.6$; $.12 < p < .89$).

4.3. Paralinguistic scale

To investigate patients' performance in the comprehension of paralinguistic elements, we conducted ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and one within-subjects factor (*type of element*, with two levels: basic communication act and basic emotion). This analysis revealed a main effect of the type of subject ($F_{(1,51)} = 18.05$; $p < .0001$; $\eta^2 = .26$): TBI patients performed significantly worse than control subjects in paralinguistic comprehension tasks. The comprehension of paralinguistic basic emotions is easier than comprehension of basic communicative acts ($F_{(1,51)} = 58.99$; $p < .0001$; $\eta^2 = .53$). As regards the comprehension of paralinguistic contradiction, we conducted a *T* test in order to compare TBI performance with that of controls: the analysis revealed that TBI patients perform significantly worse than controls (*T* test: $t = 4.54$; $p < .0001$). The results are summarized in Table 3 and Fig. 4.

To investigate performance in the production of paralinguistic elements, we conducted ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and one within-subjects factor (*type of element*, with two levels: basic communication act and basic emotion). This analysis revealed a main effect of the type of subject ($F_{(1,51)} = 13.68$; $p = .001$; $\eta^2 = .21$): TBI patients performed significantly worse than control subjects in paralinguistic comprehension tasks. The different type of paralinguistic element has an effect on TBI performance

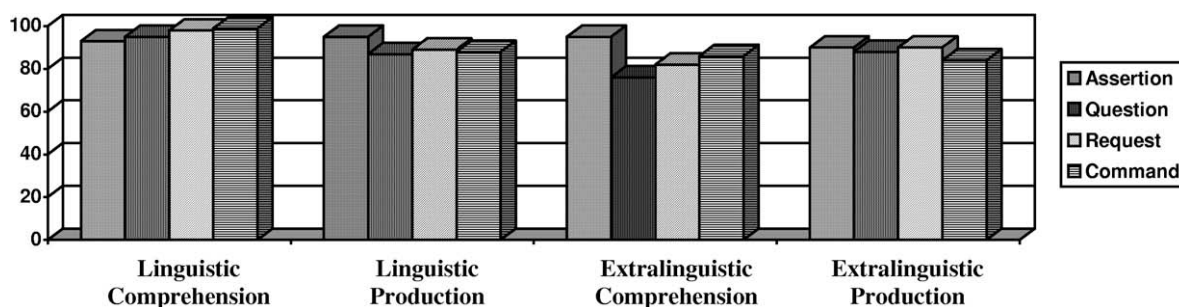


Fig. 3. Comparison between the different types of BSAs on linguistic and extralinguistic scale, both in comprehension and production.

($F_{(1,51)} = 11.54; p = .001; \eta^2 = .18$): the production of paralinguistic elements connected to basic communication acts is easier than production of paralinguistic elements connected to basic emotions (see Table 2 and Fig. 4).

4.4. Context scale

To investigate subjects' performance in comprehension on the context scale, we conducted ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and one within-subjects factor (*type of violation*, with two levels: social norm and Grice's Maxim). This analysis revealed no effect of the type of subject ($F_{(1,51)} = 2.91; p = .09; \eta^2 = .05$) and no effect of the type of violation ($F_{(1,51)} = .12; p = .72; \eta^2 = .002$). There was a significant interaction between type of subject and type of violation ($F_{(1,51)} = 4.47; p = .04; \eta^2 = .08$); consequently, we analyzed the data in depth and found that

Table 3
Mean and standard deviations (in parentheses) of the scores in the paralinguistic scale, both comprehension and production tasks

	Paralinguistic scale			
	Comprehension		Production	
	TBI	Controls	TBI	Controls
Basic communication act	.58 (.186)	.73 (.16)	.87 (.269)	.98
Basic emotion	.81 (.14)	.93 (.112)	.72 (.309)	.95
Paralinguistic contradiction	.74 (.29)	.98 (.073)	—	—

the difference between patients and controls on social norms tasks was similar (T test: $t = .32; p = .75$), whereas scores for comprehension of violation of Grice's Maxims were significantly different (T test: $t = 30.09; p = .005$). Our results are summarized in Table 4.

To investigate production performance on the context scale, we conducted ANOVA with one between-subjects factor (*type of subject*, with two levels: patient and control) and one within-subjects factor (*type of context*, with two levels: informal and formal). This analysis revealed a main effect of the type of subject ($F_{(1,51)} = 7.31; p = .009; \eta^2 = .12$), indicating that the TBI group performed significantly worse than the control group (see Table 3). There was also a main effect of the type of context involved in the different tasks ($F_{(1,51)} = 6.88; p = .01; \eta^2 = .12$), indicating that it is more difficult to produce appropriate communication acts in formal contexts than in informal ones.

4.5. Conversational scale

To investigate patients' performance on the conversational scale we used a paired T test in order to compare TBI and control subjects. There was no significant difference in either *topic elements* or in *turn-taking* (T test: $.867 < t < 1.261; .213 < p < .39$). Nevertheless, we analyzed the single scored components in more detail: the only item in which patients performed significantly worse than controls was *topic maintenance* (T test: $t = 30.4; p = .006$).

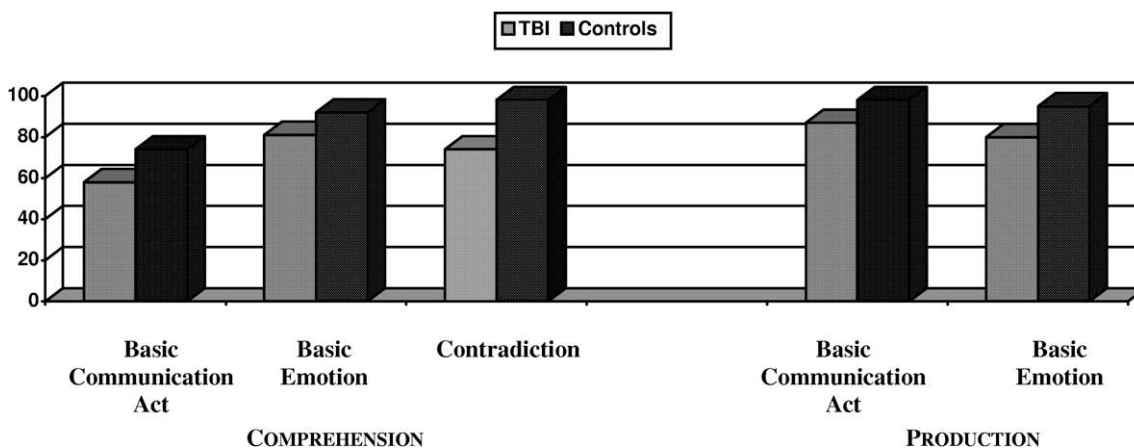


Fig. 4. Comparison between TBI patients and control subjects on paralinguistic scale, both in comprehension and production.

Table 4
Mean and standard deviations (in parentheses) of the scores in the context scale, both comprehension and production tasks

	Context scale			
	Comprehension		Production	
	TBI	Controls	TBI	Controls
Social norms	.81 (.33)	.84 (.27)	Informal	.94 (.16) 100 —
Grice's Maxims	.72 (.24)	.90 (.15)	Formal	.87 (.19) 95 (.12)

5. Discussion

The aim of this study was to present a complete assessment of the communicative abilities of TBI patients in a wide range of pragmatic phenomena, in order to illustrate their ability to manage different kinds of communicative aspects in an overall framework. ABaCo, the assessment battery utilized here as the experimental protocol, fulfills this requirement, by providing a comprehensive overview of communicative skills, consisting of several pragmatic phenomena, ranging from very easy ones—like basic speech acts—to more complex ones—like deceit and irony—taking into account both production and comprehension abilities. Moreover, it is crucial to note that the assessment is comprehensive of different communicative modalities, including the linguistic, extralinguistic and paralinguistic aspects of communication. The battery includes the evaluation of social aspects involved in communicative exchanges, such as sensitivity to context and conversational appropriateness, and the appraisal of ecological discourse management. As well as examining all these features, we also looked at the relationships between communicative performance and cognitive impairment.

First of all, we compared performance by TBI patients with that by controls in order to obtain an overview of their communicative ability: on the linguistic, extralinguistic, paralinguistic and context scales, TBI patients performed significantly worse than control subjects, in both comprehension and production tasks. No 'ceiling effect' was observed in the control group; consequently we can compare their performance with that by the TBI group. Only on the conversational scale is the difference between patients and controls not significant, although the rough measures are in the attended direction; this unexpected result is examined later on in the discussion. Let us now focus in detail on the results concerning each single scale.

5.1. Linguistic and extralinguistic scale

On the linguistic and extralinguistic scales TBI patients were found to perform worse than controls in both comprehension and production in each investigated phenomena, namely BSAs, standard, ironic and deceitful communication acts. Results concerning comprehension of irony and deceit

are in line with previous studies (Bara et al., 1997, 2001). In contrast, our TBI patients also showed difficulty with the comprehension and production of standard communication acts, expressed using both linguistic and extralinguistic means, whereas such difference did not emerge in previous studies. However, the present result is in line with Kasher, Batori, Soroker, Graves, and Zaidel (1999), suggesting that cerebral lesion to the Right and Left hemisphere can also damage elementary communication acts, and not only more complex communicative phenomena such as non-literal language or sarcasm.

Focusing on TBI patients' performance on BSAs, we investigated the possibility, as suggested by Kasher (1991), that assertion represents the easiest basic speech act, and consequently that the question, request and command require a more sophisticated ability. The results show this prediction to be correct for linguistic production and extralinguistic comprehension and production, although the single comparisons are not always significant at statistical level. Surprisingly, linguistic comprehension of assertion is more difficult than comprehension of other kinds of BSAs. We explain this unexpected result by the fact that we unintentionally introduced an additional procedural difficulty for the comprehension of assertion but not of the other BSAs. Indeed, only for assertion comprehension, after listening to an assertion did the subjects have to judge whether it was true or false. By contrast, in the comprehension of other BSAs patients were not required to make any judgment. Such experimental modification was probably cognitively more demanding.

In analyzing the TBI group in greater detail, we hypothesize that patients have greater difficulty with complex communication acts, since these require a longer inferential load. However, our results reveal no significant differences between simple and complex communication acts on either the linguistic or extralinguistic scales, with regard to all the pragmatic phenomena considered: standard communication acts, deceptions and ironies. This result suggests that the increasing length of the inferential load does not represent the crucial point of impairment in TBI communicative deficits. Such result is in line with Channon et al. (2005), who found no significant differences for comprehension of direct versus indirect sarcasm in a closed head injury group, meaning direct/indirect in a similar way to our simple/complex distinction. Taken together such studies seem to show that TBI patients are not sensitive to the distinction between simple and complex communicative acts.

By contrast the difficulty in manipulating mental representations has a wider effect on TBI patients' communicative performance. Indeed there is an increasing trend of difficulty for managing different kinds of pragmatic phenomena that involves dealing with embedded mental representations. Our results are in line with our expectations: both comprehension and production of standard communication acts are easier than deceptions, followed by ironies, which represent

the most difficult task, in both the linguistic and extralinguistic modalities. Our result concerning the comprehension of simple and complex communication acts and the increasing trend of difficulty in both the comprehension and production of standard and non-standard communication acts, follow the same pattern of results on both the linguistic and extralinguistic scales. We interpret such results as supporting our assumption that speech acts and extralinguistic communication acts share the most relevant mental processes in each specific pragmatic phenomenon investigated (Bara & Tirassa, 1999). Such data are in favor of a unified theoretical framework in which linguistic and extralinguistic communication decay in parallel as different aspects of a unique communicative competence (Bara, 2008).

To sum up, the administration of the linguistic and extralinguistic scales revealed that: TBI patients, compared to controls, show difficulties in the comprehension and production of all the investigated pragmatic phenomena, both when expressed by linguistic and when expressed by extralinguistic means. Besides, patients show an increasing trend of difficulty in the comprehension of standard, deceitful and ironic communication acts, while they do not show differences in performance in the comprehension of simplex versus complex communication acts.

5.2. Paralinguistic scale

As far as the paralinguistic scale is concerned, in recent years several studies have shown that TBI patients have particular difficulty understanding prosodic and emotional cues during discourse (Marquardt et al., 2001; McDonald & Flanagan, 2004; McDonald et al., 2004; Milders et al., 2003). Our results systematize the present literature giving a wide overview of paralinguistic ability in TBI patients, in terms of both comprehension and production. In particular, TBI patients show greater difficulty than controls in perceiving paralinguistic contradiction, which is when the expressed semantic content is discrepant with the paralinguistic elements accompanying it. They also perform significantly worse than controls in the comprehension of paralinguistic aspects of basic communication acts and basic emotions. In the production of paralinguistic aspects, TBI patients show greater difficulty than controls in accompanying both basic communication acts and basic emotion sentences with appropriate paralinguistic cues. In particular, patients perform worse both in comprehending and producing the basic communication task when compared with the basic emotion task. This result implies that TBI patients have a specific problem in taking into account paralinguistic cues studied at different levels of analysis.

To sum up, the administration of the paralinguistic scale revealed that: TBI patients, compared to controls, show difficulties in the comprehension and production of paralinguistic cues. Besides, patients show greater problems in comprehending and producing basic communication tasks rather than basic emotion tasks.

5.3. Context scale

On the context scale, according to our hypotheses, TBI patients differ significantly compared with controls in the production of appropriate communication acts in relation to the proposed social context, bearing out the idea that TBI implies social impairment amplified by the difficulty in understanding the correct rules in progress during conversational exchanges. In comprehension tasks, TBI patients only perform worse than controls with regard to sensitivity concerning the violation of discourse norms (Grice's Maxims), whereas there is no difference between patients and controls in the comprehension of violation of social norms. This is particularly surprising and is probably connected to the rehabilitation programs involving group role-playing in which our patients were involved, since they were used to being careful about violating social norms in codified and prototypical situations. It is important to note that when patients are required to produce adequate communication acts (and not only to recognize when someone does something wrong), their problems still emerge, probably because they have to find a new appropriate solution with respect to the novel context in which they are involved, without having the opportunity to use prototypical answers.

However, our datum showing the difficulty of TBI patients in comprehending the violation of Grice's Maxims is consistent with previous work (McDonald, 2000) in which there was evidence that TBI individuals have problems understanding contextual information like the nature of interpersonal relationships between speakers and inferring the meaning of interpersonal exchanges between people that present non-literal comments (McDonald & Flanagan, 2004).

To sum up, the administration of the Context scale revealed that: TBI patients, compared to controls, show difficulties in the production of appropriate communication acts with respect to the proposed social context. By contrast, in comprehension tasks, TBI patients perform worse than controls only in recognizing violations of discourse norms (Grice's Maxims), whereas they were as good as controls in comprehending violations of social norms.

5.4. Conversational scale

Finally, we found no difference between patients' and controls' performance on the conversational scale. Such result could be explained by taking into account the fact that our conversational tasks involved stereotypical arguments, based on basic topics, and consisting in a brief exchange with the examiner. For example in one task the experimenter introduced the conversational theme "Television" proposing conversational suggestions to the patient such as "Do you like watching television?", "What do you like watching?". The qualitative impression in re-examining the patients' tape-recorded performance during the conversational experimental session is that patients had a stereotypical conversation with the experimenter, but such rigidity was not captured by our scoring. In order to succeed in the task,

subjects merely had to talk superficially with the examiner about the proposed theme. On the other hand, our aim in giving the examiners simple and prototypical topics to follow was to make the task equivalent and accessible for all subjects. We probably provided a basic level of structured conversations sufficient to cover their communicative deficits.

Looking at the single components of the conversational scale, there appears to be a significant difference between patients and controls in the *topic shift* item, showing that TBI subjects have a particular tendency to persevere in the same topic during the discourse in progress, and have difficulty in changing the subject while following the stream of exchange. This is in line with a previous study (Mentis & Prutting, 1991), which provided evidence of disrupted topic management abilities.

Our patients, by contrast, show no difference in performance on turn-taking tasks when compared with healthy controls. This result contrasts with Coelho, Liles, and Duffy (1991) who found that in TBI subjects conversations are characterized by an unusual number of conversational turns, with substantial problems in initiating and sustaining conversations. Nevertheless, a pilot study by Snow, Douglas, and Ponsford (1995) demonstrated that the analysis of semi-structured conversations does not distinguish between TBI patients and matched control subjects with comparable socio-economical backgrounds, by pointing out that the nature of conversation proposed by an examiner directing the dialogue might have obscured the discourse deficits which emerge in a more ecological conversation setting. Moreover, Wozniak, Coelho, Duffy, and Liles (1999) underline that the method of eliciting conversation, with the examiner directing the conversation, produces exchanges better described as interviews. These interviews fail in gathering the real communicative impairment that TBI patients demonstrate in their everyday life. Finally, the literature highlights the need to evaluate people with TBI in different contexts with different interlocutors and different interaction goals (Togher, 2000) in order to fully describe their conversational abilities.

All these factors considered, it is not surprising that the performance by our TBI patients on conversation is quite good; but this finding should be taken with caution, given the limited ecology of the task.

To sum up, the administration of the conversational scale revealed that TBI patients, compared to controls, show difficulties in *topic shift* but not in *turn-taking* tasks.

6. Conclusion

In summary, apart from the single results discussed here, the novelty of our study consists of the fact that it presents a complete assessment able to evaluate and compare different pragmatic phenomena, expressed by different communicative modalities, in a TBI population showing various communicative deficits. In the philosophy of a cumulative research program (Lakatos, 1970),

we tried to integrate within the comprehensive framework of Cognitive Pragmatics the many isolated types of communication, up until now studied in quite a fragmentary way. Our battery seems to be a sensitive tool useful for gathering a wide range of communicative deficits in TBI patients, and providing a more cohesive picture of TBI patients' impairments for both comprehension and production, which underlie their social impairment at many levels. Moreover, our study permitted an in-depth investigation of the different modalities involved in communicative exchanges, from linguistic to extralinguistic and paralinguistic.

To summarize, the main results of our research reveal that the TBI patients we studied have a damaged but still valid linguistic comprehension. In extralinguistic comprehension, TBI patients understand standard acts as well as healthy controls, but are highly impaired in understanding deceit and irony. Production is always worse than in controls, in both the linguistic and extralinguistic modalities: in particular, irony is the most difficult communication act to produce, with very low performance compared to normal controls. Our TBI patients have a pronounced impairment in comprehending and producing paralinguistic aspects, remaining attached to the expressed linguistic content and neglecting the emotional meaning expressed through other modalities, such as, for example, through prosody. TBI patients are still competent in understanding communication acts adequate to the context in which they are uttered, but they have difficulty in grasping subtler conversational violations. In the production of communication acts that are adequate for formal contexts, they show an impairment in adjusting their communication acts to the proposed context. Finally, they achieve a good conversational level when the conversation is directed by another person through simple and superficial topics, although they have a pronounced tendency to persevere on the same topic during the dialogue.

A limit of the present study is the schematized description of the TBI population we provided. We are aware that our group results cannot be generalized to the whole clinical population, because of the large variety of lesions and communicative outcomes. For this reason future works, using ABAco, should provide a description of the communicative abilities in the adult healthy population, in order to create a normative baseline against which comparing single patient's performance and providing personalized profiles of impairment.

Acknowledgment

We thank Alessandra Ruzzini for her help in screening patients and Marco Del Giudice and Marco Zuffranieri for their help with statistical analysis.

Appendix A. Examples of ABAco items

See Fig. A1.

EXAMPLES OF ABACO ITEMS**LINGUISTIC SCALE****[1] COMPREHENSION – SIMPLE IRONY**

In a shop, Lara tries on a dress that is clearly too tight and asks Simone: “Does this dress fit me?”. Simone answers:

Simple: *Aggiungere Simple*

[2] COMPREHENSION – COMPLEX IRONY

In a shop, Lara tries on a dress that is clearly too tight and asks Simone: “Does this dress fit me?”. Simone answers:

Complex: “YOUR DIET IS WORKING WELL!”]

[3] PRODUCTION – STANDARD

Husband and wife are sitting on the sofa.

Wife: “What would you like to do this afternoon?”

EXTRALINGUISTIC SCALE**[4] COMPREHENSION – SIMPLE DECEIT**

The boy performs a gesture with which he asks for some candies. The girl doesn’t want to give him any candy. So she looks at the candies with a disgusted expression which means “They are awful!”

[5] COMPREHENSION – COMPLEX DECEIT

The boy performs a gesture with which he asks for some candies. The girl doesn’t want to give him any candy. So she looks at the candies with a disgusted expression which means “They are awful!” Complex: Rubs her hand over her stomach as if to say “I’m so hungry!”

[6] PRODUCTION – STANDARD

A man needs help in the street. He sees a car coming.

PARALINGUISTIC SCALE**[7] PRODUCTION – EMOTION****Test Questions:**

Ask me where the doctor is

- Acting sad
- Acting happy

CONTEXT SCALE**[8] COMPREHENSION – DISCOURSE NORMS**

Sister: “Where did you put my diary?”. Brother, in front of a red chest of drawers:

“In the red drawer.”

CONVERSATIONAL SCALE**[7] Theme 1: Free Time**

- What do you like doing in your free time?
- I really enjoy sport / reading / looking after my garden... (the experimenter says what he/she enjoys doing)

Depending on how the conversation proceeds:

- What sort of books do you like reading?
- Which sports do you like practicing?
- Which sports do you like watching on television?
- I am passionate about cars / football / stamp-collecting...
- Which team do you support?

Fig. A1.

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