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# **BRAIN INJURY**

**FUNCTIONAL ASPECTS,  
REHABILITATION AND PREVENTION**

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**INTECH**

# Communicative Impairment After Traumatic Brain Injury: Evidence and Pathways to Recovery

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## 1. Introduction

Traumatic brain injury (TBI) patients show a series of communicative difficulties, loading on all the dimensions that characterize satisfying communicative interactions. This chapter has three aims: first, it reviews the current literature on this topic in order to provide a complete picture of the communicative impairment in TBI patients; second, it examines the relationship between cognitive functions - i.e. executive functions and theory of mind - and pragmatic deficits resulting as a consequence of traumatic brain injury; third, it reviews the current literature on treatment planning in rehabilitation therapy and provides suggestions for the clinical practice.

## 2. Communicative deficit in TBI

The literature has shown that traumatic brain injury, (TBI), 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). However, communicative ability involves going beyond the comprehension and production of correct lexical and syntactical aspects: patients have substantial difficulty managing interactions in their everyday life, since for example they may have confused verbal behavior, inaccurate and confabulated speech (Hartley & Jensen, 1992). The discourse of TBI patients may be long-winded, poorly organized and tangential (Glosser, 1993), while some patients may have a lower than normal level of linguistic productivity, resulting in an inability to communicate their basic needs (Hartley & Levin, 1990).

From a pragmatic viewpoint, TBI patients encounter difficulties at various levels of comprehension: they cannot go beyond the literal meaning of utterances since they are not able to understand what is implied, as in the case of comprehension of sarcastic utterances (McDonald & Pearce, 1996), humor (Braun et al., 1989; Docking et al., 2000) or commercial messages which require inferential processes in order to be understood (Pearce et al., 1998). TBI patients are also impaired on the production side, to varying degrees of severity: for

example, they may have difficulty producing correct requests (McDonald & Van Sommers, 1993) or giving the interlocutor sufficiently detailed information (McDonald, 1993; for a complete review of pragmatic disorders in adults with language impairment see Cummings, 2007).

Dardier and coll. (2011) recently conducted a detailed analysis of pragmatic aspects of language use by TBI individuals, examining both comprehension - i.e., direct requests, indirect requests, and hints - and production ability - i.e., conversation during an interview situation-. The authors showed that the pragmatic skills of persons with TBI vary across tasks: patients demonstrated weakness (in topic maintenance) but also strengths (in turn-taking, comprehension of requests and hints). The authors also argued that the specific deficits observed in patients were not systematically linked to executive function performance, even if lesion unilaterality (right or left) seems help to preserve patients' pragmatic performance.

It is not only the linguistic modality that may be impaired after traumatic brain damage, but also the extralinguistic modality, that is the ability to communicate through gestures (Bara et al., 2001), and the paralinguistic modality, that is the ability to mark one's own communicative acts appropriately using cues such as tone, prosody and rhythm. For example Rousseaux and coll. (2010) evaluated the verbal and non-verbal aspect of communication in TBI patients during a dyadic interaction and found that in the chronic phase patients showed marked difficulties in speech outflow and pragmatic language - i.e. responding to open questions, presenting new information and introducing new themes, organizing discourse and adapting to interlocutor language. As far as non-verbal communication is concerned, patients were impaired in understanding and producing gestures, in affective expressivity, in feedback management and pragmatics (i.e., prosody, orienting gaze, using regulatory mimogestuality and turn-taking).

Focusing on paralinguistic communication, some authors (e.g., Ylvisaker et al., 1987) have suggested that the inability to recognize emotions expressed by other people, both through their voice and through their facial expression, may even be the causal factor for the antisocial behavior and poor social relationships of TBI patients. After traumatic brain injury it is difficult to understand prosodic aspects of speech (Joanette & Brownell, 1990), especially in cases in which prosodic elements would help in disambiguating utterances (Marquardt et al., 2001). Furthermore, the social difficulties experienced after traumatic brain injury spread to the management of social interactions, with the inability to resume and carry on normal personal relationships.

Angeleri and coll. (2008) provided a comprehensive picture of communicative performance in TBI patients, encompassing both comprehension and production of a series of pragmatic tasks, such as for example direct and indirect speech acts, irony and deceit. They analyzed a great variety of expressive modalities, including linguistic, extralinguistic, and paralinguistic communication, conversational exchange management and the ability to evaluate the appropriateness of a communicative act with respect to a given social context. The authors showed that in the linguistic and extralinguistic modalities TBI patients performed worse than controls in both comprehension and production of each investigated phenomenon, i.e. direct and indirect, ironic and deceitful communication acts. However, while impaired in comparison with normal controls, some pragmatic tasks have been found to be better preserved than others. In particular, direct and indirect speech acts are better preserved than deceit, which is in turn better preserved than irony, the most difficult task to manage. Furthermore TBI patients showed a pronounced impairment in comprehending

and producing paralinguistic aspects, remaining attached to the expressed semantic content and neglecting the emotional meaning expressed through other modalities, such as, for example, prosody. However TBI patients are still competent in understanding communication acts adequate to the context (i.e., formal vs. informal) in which they are uttered, but they have difficulty in grasping subtler conversational violations of Grice's (1989) cooperation principle (i.e., the speaker is ambiguous or confused). Lastly, TBI patients achieve good conversational performance when the interaction is principally directed by another person through simple and superficial topics, although they have a pronounced tendency to persevere on the same topic during the dialogue. All their results considered, Angeleri and coll. (2008) concluded that the TBI patients they studied had a communicative deficit but preserved abilities in some areas. Furthermore, the authors point out that even when communication is damaged some pragmatic abilities are less damaged than others, such as for example direct and indirect speech acts with respect to deceit, and deceit with respect to the comprehension and production of irony.

Some authors have suggested that the communicative inappropriateness of TBI patients represents the most impressive obstacle to patients' social reintegration, due to impairments in social communication (Dahlberg et al., 2006; Turkstra et al., 2001). All these aspects are central to 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 (McDonald et al., 2004).

### **3. Cognitive functioning in communication**

In recent years, there has been increasing interest in the cognitive aspects underlying pragmatic impairment (e.g., Perkins, 2000). In particular, some authors have suggested that cognitive abilities, such as executive functions and theory of mind, play a central role in the pragmatic performance of brain-damaged subjects (Happé et al., 1999; Martin & McDonald, 2003). TBI patients often suffer damage in the frontal lobe, the brain area involved in executive functioning - the construct used to describe goal-directed behavior - and some authors have explained the pragmatic deficit displayed by these individuals as being caused mainly by executive function impairment (McDonald & Pearce, 1998).

Theory of Mind (ToM) is the ability to ascribe mental states to oneself and to other people and to use such knowledge to interpret one's own as well as other people's behavior. Some authors highlight the role of ToM in human communication (Happé & Loth, 2002; Tirassa et al., 2006) and argue that a developed and intact capacity to mindread is necessary to comprehend a partner's communicative intention (Frith, 1992).

The relation between Theory of Mind and communicative ability is particularly apparent in individuals on the autism spectrum whose communicative and social difficulties have been noticed in several studies (e.g., Frith, 1989; Tager-Flusberg, 2006). Several authors (e.g., Baron-Cohen et al., 1985) have proposed that difficulty in social adjustment and communicative impairments typically demonstrated by autistic children were caused by a specific ToM deficit.

Only a few studies have specifically investigated ToM impairment in TBI patients (Channon & Crawford, 2010). In a focused study Bibby and McDonald (2005) tested patients with TBI on mentalistic (ToM) tasks and non-mentalistic (inferential) tasks. Their results revealed that subjects with TBI performed more poorly than controls on all tasks (mentalistic and non-

mentalic). However a more detailed analysis revealed that inference-making ability and working memory significantly predict the subject's performance on second-order stories and non-verbal ToM tasks but these factors were not significant predictors of subjects' performance on first-order ToM tasks. The authors concluded that further studies are necessary to determine whether a specific ToM deficit can be observed in relation to other tasks that demand a comparable non-mentalizing process. The authors also suggested that a number of factors, in addition to ToM deficit, may influence TBI patients' social performance, including inferential ability, language comprehension, understanding of humor and working memory. The authors concluded that rehabilitative programs should also consider these factors, in addition to ToM. However, to the best of our knowledge, no specific rehabilitative processes focusing on ToM, or on ToM plus such factors, have been created and used in TBI patients' rehabilitative treatment.

#### 4. Cognitive rehabilitation

Generally speaking, cognitive rehabilitation refers to a wide range of methods aimed at remediating or compensating for decreased cognitive abilities. However, in recent decades, it has been emphasized that treatment should focus on the *individual* rather than on cognitive functioning per se; this means that the influence of specific contextual variables on rehabilitation plans, the emotional and social aspects associated with brain injury, and their interactions with cognitive function should be clarified for each patient, in order to precisely assess the patient's particular needs. The goal of treatment is thus a functional change able to bring about meaningful changes in the patient's everyday life, including improved autonomy and satisfactory social relationships.

As researchers have shown (e.g., Chen et al., 2010, Kolb & Gibb, 1999), the brain is a plastic organ capable of considerable reorganization that can be considered the basis for functional recovery; the way in which dendritic growth, structured stimulation, and recovery of lost function are related has been well demonstrated, and this is the starting point for the utility of cognitive treatment.

Rehabilitation programs for individuals with brain injury commonly focus on attention, memory, and executive function. We will now briefly review those cognitive functions that have the greatest impact on communicative abilities, i.e. executive function and theory of mind ability.

For individuals with acquired brain injury, damage to the frontal lobe and its connections throughout the central nervous system could drive impairment in executive functioning, i.e., a cluster of deficits including planning, problem solving, initiating, and regulating behavior (Kramer & Quitania, 2007; Stuss, 2007).

A clinical model of executive functions has been proposed by Mateer (1999). This model conceives the following different domains of executive functions with wide clinical impact: 1. *Initiation and drive (starting behavior)*, 2. *Response inhibition (stopping behavior)*, 3. *Task persistence (maintaining behavior)*, 4. *Organization (organizing actions and thoughts)*, 5. *Generative thinking (creativity, fluency, cognitive flexibility)*, and 6. *Awareness (monitoring and modifying one's own behavior)*. These categories capture the wide range of cognitive and behavioral impairments that may occur when executive functions are damaged; it is important to note that these six categories, as part of the same brain network, are linked, related, and interdependent. Once the cognitive impairment has been carefully assessed, a variety of clinical approaches may be used to address executive function rehabilitation. The choice of

clinical approach is dependent upon specific variables that clinicians must consider when planning patient management. For instance, it is important to consider the time after onset, the severity of the executive dysfunction, the co-occurrence of other cognitive problems, the social support available, and the patient's level of awareness. Developing a specific and flexible treatment plan is essential in order to lead to cognitive improvement, and establish the necessary therapeutic alliance.

One of the most common rehabilitative approaches refers to *teaching task-specific routines*, which must be relevant to a specific setting (e.g., dressing, writing letters, traveling on a bus, playing solitaire and so on). After training, the patient should also be able to initiate and maintain the behavioral sequence in her/his daily life (Sohlberg & Raskin, 1996). This kind of routine is designed to produce automatic responses for specific procedures; in contrast, the therapeutic approach called *training the selection and execution of cognitive plans* aims to improve patients' ability to reinforce specific areas of executive functioning, also extending the results to related tasks. This approach considers several critical components (e.g., goal selection, planning/sequencing, initiation and so on) and suggests specific exercises to improve performance in those areas: examples are planning repeated activities in role-play situations, practicing specific tasks also in naturalistic contexts (e.g., getting a bus schedule), and completing activities according to time constraints.

A different rehabilitative approach is *teaching to use metacognitive routines*. In this case, patients have to modulate their own behavior by talking to themselves using self-instructional techniques (Alderman et al., 1995; Fish et al., 2008; Levine et al., 2000). This approach leads patients to regulate their behavior and autonomously complete goal directed activities. In line with these aims, Von Cramon and Matthes-von Cramon (1994) proposed *problem-solving therapy* groups, a treatment based on the idea of substituting the patient's impulsive behavior with a verbally-mediated, systematic analysis of the goal and the means by which it may be achieved. The problem-solving intervention focuses on the development of self-regulation strategies as the basis for maintaining an effective problem orientation (Rath et al., 2003).

Cognitive rehabilitation has also been used to successfully remediate the social perception deficit, i.e. deficit in emotion perception, commonly experienced by TBI patients (Bornhofen & McDonald, 2008). The treatment program consists of tasks involving the recognition of specific patterns of changes in facial expressions, voice tone and body posture during the expression of different kinds of emotions. These tasks consist in interpreting conventional emotional contexts (i.e., knowledge regarding emotions typically expressed in scenarios such as birthday parties, funerals, and so on), judging static (i.e., photograph) and dynamic (i.e., video or role-play) emotion cues and making social inferences on the basis of emotional demeanor and situational cues (i.e., regarding whether a speaker is sarcastic or lying, rehearsed via therapist modeling, video sequences and role play).

## 5. Communicative rehabilitation

People express their communicative ability via different expressive means, for instance, using linguistic, gestural and paralinguistic modalities. However, the majority of studies in the literature have focused primarily on remediation of the linguistic modality.

The major limit of interventions exclusively focused on language is that after the therapy patients are often impaired in solving communicative difficulties in everyday life situations. The pragmatic approach has been developed to overcome this limitation (for a review see Carlomagno et al., 2000). The pragmatic view has shifted the focus of therapeutic practice

from the patient's linguistic ability to the effective use of language in a given context and was first used with aphasic patients. Functional pragmatic therapies also focus on a patient's residual communicative abilities, such as for instance gestural and prosodic skills in aphasic patients, and look for alternative and compensatory communicative strategies with respect to the defective ones. Aten, Caligiuri and Holland (1982) were the first to develop a successful formal pragmatic therapy program, the *Functional Communication Treatment*, in which aphasic patients were confronted with simulated everyday life situations and trained in the use of non-verbal communicative strategies. Holland (1991) further expanded this treatment by introducing *Conversational Coaching* therapy. The aim of this method, based on the use of short monologues, is to train patients to control the quality of the monologue depending on the degree of familiarity with the listener – from relatives to unknown persons – and the informativeness of the script – from known information to improbable events. A further example of the use of the functional pragmatic approach, backed by experimental evidence, is *Promoting Aphasics Communicative Effectiveness* (Davis & Wilcox, 1985). The treatment requires that therapist and patient sit facing one another across a table on which are a set of printed stimulus cards. In turn, each participant takes a card and, without showing it, he tries to describe it to the other person. The therapeutic basis of this treatment is that it involves a progressive exercise within the setting of natural conversation, supported by a therapist eliciting compensatory strategies and providing useful feedback, which improves the patient's linguistic and communicative performance.

Within the pragmatic approach, an important setting for practicing pragmatic therapies is the group (Marshall, 1999). Group communication treatments focus on initiating conversation and conveying a message, understanding the communication disorder, being aware of personal goals and progress and having confidence in being able to communicate in personally relevant situations (Elman & Bernstein-Ellis, 1999).

Ehrlich and Sipes (1985) described a model of group intervention specifically for TBI patients based on the functional pragmatic approach. The treatment consisted of four modules focused on improving non-verbal communication, appropriate communication in context, message repair and message cohesiveness. The therapist role-played and videotaped both appropriate and inappropriate examples of target behavior. The videos were examined and reviewed by the group under the supervision of the therapist, who pointed out the inappropriate behavior and suggested possible appropriate alternatives. After treatment patients showed improvements in the reformulation of inappropriate messages, sentence cohesion and in the introduction and development of conversational topics.

TBI patients have been found to have, in particular, social communication problems (Dahlberg et al., 2006). Social communication interventions include therapies such as group discussion, forming communication goals, modeling, role-playing, feedback, self-monitoring, behavioral rehearsal and social reinforcement (Struchen, 2005). For example, Bellon and Rees (2006) examined the role of social context on language and communication skills among TBI patients, demonstrating the notable benefits of carefully structured supportive social networks. The key component of their rehabilitation intervention was the presence of a mentor, who prompted the patients and gave them cues and models of positive behavior; this kind of social support stimulated patients' positive self-image, positive self-talk and inter-personal language. Ylvisaker (2006) presented an intervention for TBI patients based on self-coaching which was aimed at improving planned, goal-oriented and successful behavior.

Lastly, further rehabilitative treatments focus on training the partners who communicate with patients affected by TBI (Togher et al., 2004); the goal of such interventions is to

improve the quality of conversational interactions, enhance the listener's ability to comprehend and promote the patient's communicative attempts. The listener's attitude can in fact shape the patient's language, communicative behavior and motivation, reducing the social isolation typically resulting as an outcome of brain injury.

## 6. Conclusions

Traumatic brain injury, (TBI), patients show a series of communicative difficulties, however such difficulties may vary across the communicative tasks and the expressive modalities investigated, showing large individual differences with specific areas of weakness and strength. One of the first steps in designing an effective rehabilitation program is thus to define an in-depth and articulate assessment of the deficit/preserved ability of a specific patient taking into consideration different pragmatic phenomena and expressive modalities. Empirical studies also suggest that cognitive abilities, such as executive functions and theory of mind, may have a role in the communicative performance of brain-damaged subjects, however only a few studies have systematically investigated the role played in TBI by ToM and executive function impairment and such relationship is not sufficiently explained. Further studies are thus necessary to clarify this relationship and to support the possibility of including specific cognitive training in treatment aimed at improving communicative ability in TBI patients.

Several communicative rehabilitation treatment programs already exist and the effectiveness of functional pragmatic therapy after TBI is supported by empirical data. However, given the limited number of studies in the literature and the small samples considered, further confirmation is necessary.

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