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Communication Impairments in Patients with Right Hemisphere Damage

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Abstract

Right brain damages can manifest deficits of communicative skills, which sometimes cause an important inability. The communication impairments following a right hemisphere damage are distinct from those in aphasia and may affect discursive, lexico-semantic, pragmatic, and prosodic components of communication.

It is calculated that this troubles affect almost a 50% of this patients. However, these impairments have essentially been studied separately and their possible coexistence in a same individual is still unknown. Moreover, the clinical profiles of communication impairments following a right hemisphere damage, including their correlation with underlying cognitive deficits, are still unreported.

The goal of this article is to offer an overview of the verbal communication deficits that can be found in right-hemisphere-damaged individuals. These deficits can interfere, at different levels, with prosody, the semantic processing of words and discourse and pragmatic abilities.

In spite of the incapability that they produce, communicational impairments in right brain damaged are usually neglected. Probably, the sub-diagnostic is due to the lack of an appropriate classification or to the absent of adequate assessment tools. In fact, patients with right brain damages might present harsh communicational deficits but perform correctly on aphasia tests because the last ones are not designed to detect this kind of deficit but left brain damaged impairments.

Increasing our knowledge about the role of the right-hemisphere in verbal communication will have major theoretical and clinical impacts; it could

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facilitate the diagnosis of right brain patients in the clinical circle and it will help to lay the foundations to elaborate methods and strategies of intervention.

Keywords: Right hemisphere, Verbal communication, Lexical, Semantics

1. Introduction

Over the last fifty years, the incorporation of pragmatics into neurolinguistics has had a strong impact on the way language impairments are conceived theoretically and clinically. Whereas late-19th-century linguistic advances emphasized the predominant role of the left hemisphere, studies during the second half of the 20th century demonstrated that rich and efficient verbal communication depends on the soundness of both cerebral hemispheres.

For a long time, the clinical description of acquired language disorders (aphasias) was based on traditional linguistic components such as phonology, semantics, and morphosyntax. Thanks to contributions made by psycholinguistics and modern cognitive psychology, the very concept of language has evolved radically since the 1950s. Prosodic, discursive, and pragmatic aspects were added to the traditional dimensions of linguistics, all of which now have their own place within the study of acquired language disorders, particularly those caused by right brain hemisphere damage (RHD). It is known today that the right hemisphere plays an essential role in human behavior and that it intervenes decisively in the regulation of the pragmatic dimension of verbal communication.

Although the language disorders that are present in individuals with RHD are, on the whole, different to those seen in patients with left hemisphere damage (LHD), this does not make them any less significant from a clinical point of view. A patient with RHD can, amongst other things, show difficulty transmitting communicative intentions based on emotions, on modulation of speech parameters, and on indirect meanings of discourse or figurative language. This has consequences not just for the affected individual, but also for those around them, and the functional and psychological impacts on the person's life can be considerable. Language disorders constitute a significant obstacle to developing and maintaining satisfactory interpersonal relationships, and they can be detrimental to the resumption of an active social and professional life.

Today, advances in theoretical and clinical knowledge allow us to better recognize the presence of communication disorders linked to impairment of the right cerebral hemisphere. However, affected individuals still go unnoticed by health professionals even today. Language deficits caused by

RHD are, as a whole, different to those seen in aphasia. Despite their difficulties in processing the elemental structures of language, aphasic patients can often make use of contextual keys in order to communicate. Those with RHD have the opposite problem: although their phonological and syntactic abilities remain intact, they have serious difficulties in establishing adequate relationships between language and the context in which it is being used (Abusamra, Martínez Cuitiño, Wilson, Jaichenco, & Ferreres, 2004).

As a consequence, problems caused by RHD cannot be assessed using classic aphasia evaluation batteries such as the *Montreal–Toulouse Protocol for Language Assessment of Aphasia* (Nespoulous, Lecours, Lafond, Lemay, Puel, Joanette *et al*., 1992), the *Battery for the Analysis of Aphasic Deficit* (Miceli, Laudanna, & Burani, 1994; Ferreres, Grus, Jacubovich, Jaichenco, Kevokian, Piaggio *et al.,* 2000), or the *Boston Diagnostic Aphasia Examination* (Goodglass & Kaplan, 1979; 1983).

Insofar as it is possible for these patients to present little or no deficit in formal language tests, their pragmatic impairments go unnoticed when these tools are applied.

There are some specially designed protocols used to assess communication in individuals with RHD: *Right Hemisphere Communication Battery,* RHCB (Gardner & Brownell, 1986); *Mini Inventory of Right Brain Injury,* MIRBI (Pimental & Kingsbury, 1989); *Right Hemisphere Language Battery,* RHLB (Bryan, 1989); *Ross Information Processing Assessment,* RIPA (Ross-Swain, 1996); *Evaluation of Communication Problems in Right Hemisphere Dysfunction, revised* (Halper, Cherney, Burns, & Mogil, 1996), *Protocolo de Evaluación de Funciones Lingüísticas y Comunicativas* (Protocol for the Evaluation of Linguistic and Communicative Functions), PELCHD (Labos, Zabala, Atlasovich, Pavón, & Ferreiro, 2003).

Despite the high quality of these protocols, most have theoretical and methodological limitations (Joannette & Ansaldo, 1999). In some cases, there has been difficulty adapting theoretical foundations to clinical demands: designs seem to be based more on practical requirements than explicit theoretical foundations. Besides, no battery takes all of the processes that have been associated with RHD into account.

In 2004, Joannette, Ska & Côté introduced a protocol to be used for the evaluation of language deficits in patients with RHD into clinical settings.

2. Historical Context

The systematic scientific study of the brain began during the Renaissance. However, for several centuries, the roles of the two hemispheres were not differentiated. It was not until the middle of the 19th century that the studies on the neurological impairment of language carried out by Marc Dax (1836) and Paul Broca (1865) began to demonstrate the asymmetrical

nature of the brain's functional organization. For almost a century afterwards, control of the language function was assigned exclusively to the left hemisphere, which was also considered the only cause of aphasia as a result of brain damage. As such, while the concept of cerebral dominance was asserted, the right hemisphere took on the dubious status of 'the minor hemisphere'. With the exception of the specific roles attributed to it by a few authors (such as Jackson, 1879), the right hemisphere was sunk in a century of obscurantism and the theory of cerebral dominance denied it any role in the maintenance of linguistic behavior.

In the 1960s the right hemisphere began to be assigned a role in linguistic abilities as a result of two groups of observations, one clinical and the other experimental. The first suggestions emerged from detailed clinical observation of patients with brain damage (Eisenson, 1959; 1962; Critchley, 1962; Weinstein, 1964). Nevertheless, these pioneers did not manage to create a precise, detailed description of right hemisphere function and stayed within the conceptual frameworks of the time. Eisenson (1962) talked of impairments to the "supra-ordinal" aspects of language; whereas Critchley (1962) noted the loss of "subtle" abilities, but was unable to classify them in more detail. The clinical impressions of Eisenson and Critchley are in keeping with the impairments in lexico-semantics, prosodic, discursive, and/or pragmatic skills that are described today.

The second set of events that connected the right hemisphere with language abilities took place some years later. At the end of the 1960s and during the 1970s, systematic studies of the language capacities of each of the hemispheres began, amongst others, on individuals with surgical section of corpus callosum (Code, Wallesch, Joanette, & Lecours, 2002). These observations, together with others carried out with a different methodological focus, confirmed the predominance of the left cerebral hemisphere in language. At the same time, they allowed the right hemisphere's capacities in the treatment of word meaning and other aspects of language to be identified. As more appropriate conceptual models were provided, clinical investigation led to the recognition of the language components that could be affected in patients with RHD. From then on, descriptions of the impact of right brain damage have aimed to investigate communication impairments.

3. The right hemisphere and verbal communication

Right hemisphere damage can cause serious disruptions to verbal communication and can affect the prosodic, lexico-semantic, discursive, and pragmatic components of language. These components are not impaired in all patients with RHD, but approximately 50% of patients are believed to have been affected in one or more of them, which could constitute a significant disability (Joanette, Goulet, & Daoust, 1991). Thus, as brain damage

can affect one or more of the components, different impairment profiles are generated according to which have been affected.

3.1 Prosodic impairments

Prosody is the modulation of the suprasegmental parameters of speech (tone, intensity, and duration) which takes place in order to transmit a communicative, linguistic, or emotional intention. Linguistic prosody includes emphatic lexical accentuation (e.g. JOHN drinks coffee vs John drinks COFFEE) and the expression of modality or of the sentence type (e.g. statement, question). Emotional prosody refers to the variations in intonation that allow emotions to be transmitted (e.g. happiness, irritation). Numerous studies have demonstrated the presence of prosodic disorders in individuals with RHD, in terms of both perception and production (Pell, 1999; Walker & Daigle, 2000). The impairment of emotional prosody may be a very evident trait, but deficits in linguistic prosody are equally marked.

In terms of production, from a clinical point of view, patients with RHD may display monotonous intonation caused by a flattening of the prosodic curve. Those with RHD tend to produce similar emotional intonation patterns to normal subjects, but with significantly reduced tone variation. This difficulty in modulating tone can affect the transmission of linguistic messages, especially those that communicate linguistic modality (Pell, 1999).

In terms of perception, patients with RHD show difficulty in understanding the intention carried by their interlocutor's prosody. Faced with an emotional prosody perception task, the identification of feelings transmitted by the interlocutor may be disturbed if the sentence has a neutral linguistic content (Tompkins & Mateer, 1985; Walker & Daigle, 2000). Although the dominant role in linguistic prosody perception is often attributed to the left hemisphere, recent studies have shown that patients with LHD perform worse than control subjects in tasks in which they have to distinguish the intonation patterns that express linguistic modality (Walker & Daigle, 2000). In short, a person with right brain damage can have serious difficulties in processing linguistic prosody and emotional prosody, both receptively and productively.

3.2 Lexico-semantic impairments

The lexico-semantic dimension of language refers to the ability to understand and express words. People with RHD do not tend to exhibit marked anomia during conversation, and, on the whole, they carry out convergent tasks like naming images without difficulty, although some authors have observed minor deficits in some cases (Diggs & Basili, 1987). In contrast, subtle lexico-semantic disorders have been observed in a significant number of people with RHD when the task demands divergent semantic treatment For example, in tasks where instructions require the production of the highest possible number of words according to a given criteria (for

example, "say the names of as many animals as you can" or "say as many words that begin with *p* as you can"), those with RHD tend to produce fewer words than control subjects and to activate peripheral semantic links, producing words that are not strongly connected and which are not very prototypical. Despite initially contradictory results, it has been shown that individuals with RHD may have difficulty when evocation must follow semantic, phonological, or orthographic criteria (Sabourin, Goulet, & Joanette, 1988) or even in the absence of any criteria, when evocation is completely free (Beausoleil, Fortín, Le Blanc, & Joanette, 2003).

The capacity to establish semantic relationships between words may also be altered in patients with RHD (Chiarello & Church, 1986). This difficulty is more marked when there is a need to access words in a precise category (e.g. vegetables, tools) in order to explain the relationship (Myers & Brookshire, 1995). Lexico-semantic deficits in individuals with RHD are especially apparent when processing isolated words of low concreteness or low frequency (Joanette & Goulet, 1990).

Finally, another specific difficulty that may be present in patients with RHD has to do with processing metaphoric or non-literal meanings of words (Gagnon, Goulet, Giroux, & Joanette, 2003). Patients with RHD obtain worse results than normal subjects when trying to choose from a pair of images the one that appropriately depicts a metaphorical enunciation; frequently, they opt for the one showing a literal interpretation of the enunciation (Winner & Gardner, 1977; Myers & Linebaugh, 1981).

3.3 Discursive impairments

Discursive skills allow information to be transmitted by a speaker to an interlocutor in a conversational, procedural, or narrative form. Information exchange involves the expressive and receptive levels of communication, depending on whether a message is being transmitted or received. The discursive dimension has mainly been studied through narrative discourse, and it is known that this ability can be affected by RHD.

As regards expression, the discourse of patients with RHD is often less informative than that of control subjects, although a similar quantity of enunciations is produced (Joanette, Goulet, Ska, & Nespoulous, 1986; Lojek-Osiejuk, 1996). Individuals with RHD provide less information than normal subjects, and this information is organized more simply, despite both groups' narrative outputs being equal in terms of number of words and general discourse structure. Measurements of the formal aspects of lexicon and syntax show that both groups function equivalently (Jainchenco, Abusamra, & Molina, 2004). As such, the deficit must lie elsewhere: lack of coherence and a strong tendency to tangential discourse are all part of the typical profile of individuals with RHD (Davis, O´Neil-Pirozzi, & Coon, 1997). According to Wapner, Hamby and Gardner (1981), what distinguishes patients with RHD from aphasic patients is their tendency to make in-

appropriate comments or to stray from the topic of the story. For example, the patient OP, who was evaluated with the MEC Protocol narrative discourse test (see Appendix, 1), produced the following discourse:

> *There was a farmer who was digging a hole uh uh uh uh well he was digging a hole until at a certain depth...uh uh uh uh...er. who was digging a well eh eh eh so he was digging with a shovel and a pick ..uh uh uh... objects that don't look like what we call shovel and pick I mean they have really something to do with the ground...not only uh uh uh...generally a wine...the farmer moves the it it it more with shovel than pick or at least like a pick. And so he went down to a certain depth and he was, was tired, it was night and so and the next day...he sees the well has collapsed I mean collapsed from a part of of of of You don't remind me any more...*

At the receptive level, many studies show that patients with RHD have difficulty integrating the elements of a story into a coherent whole, which would allow them to make the inferences necessary to understand the text adequately. Integration difficulties become more intense when listening conditions are not ideal (Titone, Wingfield, Waters, & Prentice, 2001). In general, individuals with RHD often do not grasp – or initially grasp but subsequently lose – the main idea of a piece of discourse, and have problems suggesting a title for a story or even choosing a sentence that summarizes the main topic. This attitude is in total contrast to that of normal subjects, who willingly cast secondary elements aside in order to maintain the global coherence of the story.

Problems in producing and understanding discourse are made particularly manifest in the task of retelling a story. In these cases, patients tend to introduce digressions of a personal nature as well as critiques of the story's content. Sometimes, they may provide inadequate conclusions or produce a different story based on a specific detail of the original (tangential speech). Patients with RHD adopt a specific attitude when the story contains contradictory or unusual information. Not only are they capable of remembering the unusual elements in detail, they also have a tendency to justify them.

Patients with RHD have difficulty making inferences and forming syntheses, and have trouble with some aspects of executive functions. For example, correlations have been observed between performance at tasks that require verbal inhibition and are dependent on executive functions, and text processing. Patients with RHD fail at some neuropsychological tests like the *Hayling Test* (Burgess & Shallice, 1997; Abusamra, Miranda, & Ferreres, 2007), a verbal completion test that measures the capacity to initiate and inhibit verbal information. The Hayling test is structured around two different sections. In the first section (initiation), the task consists of completing a sentence in a logical fashion with a word that is consistent with the context of the sentence. For example, "Juan greeted Laura with a… KISS, HUG, etc." In the second (which measures suppression), subjects must

complete each sentence with a word that is inconsistent with the context: "On the first line, write your… PILLOW, BOOMS, etc."

This difficult in inhibiting the correct option and producing a word that is far from the syntactic semantic context of the sentence correlates directly with the altered performance that patients show in text comprehension tasks.

As mentioned above, in recent years a hypothesis has arisen which suggests that the performance of poor comprehenders could be due to a difficulty in inhibiting irrelevant information (Gernsbacher, 1990). Suppressing unnecessary information not only reduces interferences, it also prevents information overload on working memory. If successful comprehension depends on constructing mental representations and subsequently updating them, then selecting adequately from relevant material, focusing on the main information, and inhibiting irrelevant information would be an essential step. When this mechanism loses operational capacity – as is the case with poor comprehenders – comprehension is affected because activation is indiscriminate, and the system is overloaded and lacking in other available resources.

3.4 Pragmatic impairments

Pragmatics are the linguistic and extralinguistic skills that allow an individual to process (understand and/or express) communicative intentions in a specific situational context (Gibbs, 1999). From this point of view, a speaker intends to produce a certain effect in the listener and hopes the listener will recognize it. This recognition of the speaker's intention establishes an *intentional pact*, which is what makes communication possible. As such, understanding what another person is saying to us involves much more than knowing the traditional meanings of words and the relationships between them. It implies understanding the systematic relationship that is formed between what we want to say and what we actually say, between what is said and what is not, between the explicit and the implicit.

As a discipline, pragmatics is at the crossroads between different fields of study: philosophy, linguistics, sociology, anthropology, and psychology. It studies how speakers understand and produce communicative acts in a concrete speech situation; that is, it is related to the use and interpretation that speakers give specific enunciations in a particular context.

Pragmatic skills are especially implicated in the production and interpretation of different forms of figurative language (indirect speech acts, irony, sarcasm, humor etc.) in which the explicit or literal content of the message does not coincide with the communicative intention.

One of the salient characteristics of patients with RHD is their inability to respect the principle of cooperation that regulates conversation. Amongst other things, they have difficulty respecting turn-taking, maintaining appropriate visual contact with their interlocutor, and controlling the

progression and coherence of the topic during the communicative exchange. Some also find it complicated to adapt their verbal production to the context of the knowledge shared with each interlocutor (Chantraine, Joanette, & Ska, 1998). In this situation, patients' contributions may seem repetitive or redundant, or, in contrast, they may consider certain information to be common knowledge even when it is not.

Damage to the right hemisphere can, in some cases, cause substantial changes to an individual's communicative behavior, affecting their capacity to adapt their messages to their interlocutor and the situational context.

From a receptive point of view, some patients with RHD have difficult understanding speech acts in which the intention is not explicitly mentioned in the linguistic message. The comprehension of indirect enunciations entails going beyond their literal meaning and depends on the use of personal knowledge and an understanding of the context. The difficulty increases when the indirect enunciation is not conventional (Stemmer, Giroux, & Joanette, 1994). Indeed, patients don't usually have difficulty interpreting conventional, established indirect speech acts like "Could you pass me the salt?" They do, however, find it hard to interpret indirect speech acts generated by specific references to the context of the conversational exchange. For example: "*Oscar is moving house next Saturday. He knows it's going to be a tough job because he has to take a lot of boxes to his new house. He runs into a friend in the street and, after telling him that he's moving, he says, 'What are you doing this weekend?'"*

Although they have already been dealt with in the section on lexico-semantic impairments, metaphors – like indirect speech acts, sarcasm, or irony – translate an intention which is different to the initial literal meaning. As such, they are also an object of study for pragmatics.

What follows is an example of how the patient OP fails to interpret metaphors (see Appendix, 2).

E: What does this phrase mean: My friend's mother-in-law is a witch?
P: Let's change also one word: My son-in-law's mother-in-law is a witch?
E And so what does it mean?
P.I know she is a person who hasn't had a pleasant life, throughout her marriage. That...that she's about to be separated from her husband; I'm referring to the mother-in-law of my son-in-law (ha, ha, ha)
E. OK it's not important- it's the same.
P. Certainly! The mother-in-law of my son-in-law. The mother-in-law of my son-in-law is a witch!
E What does being a witch mean?
P Because the woman is separated, because all her life she has criticized her husband for the way he is; only seen in his defects, who has kept his daughter all her life under a glass bell and she's now a poor lady because she can't find the fiancè her mother would like.

E So what does witch mean, then?
P What does it specifically mean? It means being tied-down to religious sects, to religions, to umbanda… who knows, there are so many.
E So therefore, "The mother-in-law of my son-in-law is a witch"? Does it mean the mother-in-law of my friend practices black magic? And the mother-in-law of my friend has many brooms and she is also a bad person an rude?
P: It's absolutely clear. My friend's mother-in-law has many brooms...no! My friend's mother-in-law practices black magic.

The patient is unable to understand the metaphor not only because he interprets each option literally, but also because he cannot avoid referring to himself with each metaphor he is presented with. This behavior, strongly linked to the literal, is one of the peculiarities of patients with RHD.

4. Communication impairment profiles

Very few studies have dealt with the occurrence rate of communication impairments and the possible clinical profiles in patients with RHD. However, clinical experience clearly demonstrates that not all patients with RHD have trouble with the communication deficits described thus far. According to Joanette *et al*. (1991), approximately 50% of patients may be affected by one or more communicative impairments. This proportion is similar to that of people with LHD who suffer persistent language disorders (aphasias). When present, deficits seem to be the result of cortical damage, generally in the perisylvian area, as is the case with aphasia. However, a recent study on a random group of patients with RHD found that around 80% of the sample showed communication impairments when diagnosed using structured clinical observation as well as formal evaluation (Côté, Payer, Giroux, & Joanette, 2007).

The way in which communication deficits present themselves clinically is also very significant. As happens with aphasias, not all patients with RHD and communicative disorders have the same deficit pattern. In some cases, only one of the components (prosody, semantic processing, discourse, or pragmatics) is affected; in others, the impairment can be detected in more than one component. As such, the clinical patterns of communication impairments are heterogeneous. The work of Côté *et al.* (2007) focused on this issue by applying a hierarchical cluster analysis to the results of 28 patients with RHD using MEC protocol. The study identified four groups on the basis of the similarity of patient results in protocol tasks that evaluated communication skills. In the first group, impairments were observed in the four areas the protocol evaluates: lexico-semantic, discursive, prosodic, and pragmatic skills. The second group was characterized by having retained its

discursive skills, relatively speaking. None of the skills of the third group were affected, and the fourth only showed a deficit in their lexico-semantic skills. This same study found no correlation between the location of the RHD and the pattern of impairment to communicative skills. However, the third group (which obtained normal results) showed a high incidence of subcortical damage. On the other hand, the majority of patients with frontal damage were in group two (characterized by the relative retention of discursive skills).

In short, communication impairments can be observed in at least half of all patients with RHD. When these impairments manifest themselves, they can take a variety of clinical forms, from an isolated disorder in one component of communication to various clinical profiles associated with impairments in more than one component. For this reason, physicians must be especially careful in their diagnosis, and should not expect all patients with RHD to behave identically.

5. Conclusions

The association between the left hemisphere in right-handed people and language ability has recently been explored in more detail. The right hemisphere in right-handed people has also proved to contain some skills for processing certain components of language, more related to content than to form. Along these lines, it has been proved that RHD can cause impairments to prosody, the semantic processing of words, and discursive and pragmatic skills. Although the exact origins of this disorder remain unknown, it is thought that they may correspond to specific deficits in patients with RHD, to impairments that can be present both in individuals with RHD and LHD, or even to a non-specific impact on the limited availability of cognitive resources.

Although the rate of occurrence of communication disorders in patients with RHD is yet to be determined, no estimates place it below 50%. In clinical practice, these patients tend to be under-diagnosed, which is due as much to a lack of clinical suspicion as to the fact that the batteries which evaluate aphasia do not detect their impairments. The specific evaluation tools that are now available allow non-select populations of patients with RHD to be studied. This will allow the occurrence rate of communication impairments to be reliably determined, which will, in turn, have an impact on the development of treatment techniques and the adaptation of relevant health policies.

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Enclosed

1. Narrative text - MEC Protocol (Joanette et al., 2004; Ferreres et al., 2007)

John is a farmer from the north. He has been busy for several days digging a well on his land. The work is almost over.

This morning John has arrived to finish his work and sees that during the night the well has collapsed and half of it is filled with earth. He's very upset about this. He thinks for some minutes and says to himself, "I have an idea." He leaves his shirt and cap on the edge of the well, hides the pick and pail, and climbs up a tree to hide himself.

Later, a neighbor passes by and approaches John to talk to him a little. When he sees his shirt and cap he thinks John is working at the bottom of the well. The fellow passes near by, bends down a little, and sees the well half-filled with dirt and starts to desperately cry out, "Help! Help! Friends! Come immediately! John is buried under the well.!..."The neighbors run towards the well and start digging to save poor John. When the neighbors stop taking away the earth, John comes down the tree, approaches them and says, "Thanks a lot, you've been a great help."

2. Examples of metaphors - MEC Protocol (Joanette et al., 2004; Ferreres et al., 2007)

1) The Chemistry Professor is a sweet

A. The Chemistry professor is made of chocolate
B. The Chemistry professor is very desirable and very attractive
C. The Chemistry Professor produces sweets

2) Is my friend's mother-in-law a witch?

A. My friend's mother-in-law practices black magic
B. My friend's mother-in-law has many brooms
C. My friend's mother-in-law is very mean and rude.