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Grado en Estudios Ingleses

TRABAJO DE FIN DE GRADO

AN ANALYSIS OF THETA ROLES IN APHASIC SPEAKERS' SPEECH PRODUCTION

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2018-2019

ABSTRACT

This dissertation is an empirical study on theta role assignment in aphasics' linguistic production. Its aim is twofold: to address whether aphasics follow specific patterns regarding the form and function of the Determiner Phrases (DPs) that are assigned theta roles, and to know whether theta role assignment is an impaired stage of the speech production process and, if not, which causes deficits on aphasics' speech production. To this purpose and considering previous empirical studies on aphasics' language, the use of verb assigned theta roles by one anomic aphasic and one Broca's aphasic is analysed. Conclusions reached from this analysis reveal that (1) specific patterns in terms of theta role type and DP form and function are followed by anomic and Broca's aphasics, and that (2) it is confirmed that the theta role assignment process is not altered, and that linguistic deficits come from aphasics' difficulties in accessing phonological representations of lemmas from their lexicon.

Key words: theta roles, speech production, Broca's aphasia, anomic aphasia.

RESUMEN

Este Trabajo de Fin de Grado es un estudio empírico sobre la asignación de los papeles temáticos en la producción lingüística de afásicos. El objetivo es determinar, por un lado, si los afásicos siguen patrones específicos considerando la forma y la función de los sintagmas determinantes a los que se les asignan papeles temáticos; y, por otro lado, si el proceso de asignación de papeles temáticos está alterado y la causa de los déficits lingüísticos en afásicos. Para ello, y partiendo de estudios empíricos previos sobre el lenguaje de los afásicos, se analiza el uso de papeles temáticos asignados por verbos de un anómico y de un afásico de Broca. Las conclusiones alcanzadas son: (1) que los anómicos y afásicos de Broca siguen un patrón según el tipo de papel temático y la forma y la función; y (2) que el proceso de asignación de papeles temáticos no está alterado y, los déficits del lenguaje que presentan provienen de las dificultades de los afásicos cuando acceden a las representaciones fonológicas de los lemas en su léxico.

Palabras clave: papeles temáticos, producción del lenguaje, afasia de Broca, afasia anómica.

CONTENTS

1. Introduction

Due to different factors and causes, people suffer strokes. Many of the damages associated to the different pathologies affect brain's left hemisphere, where speech areas are located. When an area in charge of speech is affected by a stroke, speech impairments are produced, as for instance aphasia. Depending on the affected area of the brain, aphasics have specific deficits in speech production and comprehension.

Nowadays, aphasic speakers have access to many treatments in order to improve speech production and comprehension. These types of pathologies are more and more studied both to be prevented and to find a solution to their effects. However, most of the studies are produced from a clinical point of view, rather than from a linguistic one. For this reason, the present dissertation contributes as a linguistic study of aphasic speakers' speech production.

The study analyses the speech production of two participants, one Broca's aphasic and one anomic aphasic. From their speech, the focus of analysis is placed on theta roles which are a semantic-syntactic feature of language. Theta roles have been analysed in terms of the DPs (Determiner Phrases) they are assigned to and both the form and function of these DPs is analysed in order to establish patterns in the aphasic speakers' production. There are different classifications of theta roles, and the one considered in this study is Haegeman's (1994). Among the theta roles, the ones the present dissertation will target are those assigned by the verb and assigned to DPs which function as subjects, direct objects and indirect objects.

Throughout the analysis of theta roles, this study aims to contribute to previous linguistic studies on aphasics' speech production. Also, its aim is to check whether aphasics' theta role assignment is impaired, and if it is not, which stage of speech production is altered for each participant.

For this purpose, the present dissertation is divided into eight sections (apart from the introduction). First, a theoretical background on aphasics and on theta roles is provided. Second, previous empirical works on aphasics' language has been considered. Third, three sets of research questions according to patterns of (1) form, (2) function, and (3) theta role assignment are presented. This will guide the data analyses. Fourthly, the methodology followed in the present study is presented. This includes the selection of data from one anomic and one Broca's aphasic from the Fridriksson Corpus of Aphasia Bank (MacWhinney, Fromm, Forbes and Holland, 2011) and the data classification criteria followed. Next, the results of the study are presented and discussed in terms of the research questions. And finally, the conclusions section includes the conclusions reached from the dissertation. The dissertation ends with a bibliography section.

To accomplish this study, data have been compiled in a database where they are classified and analysed. This is done on an Excel spreadsheet attached to the dissertation in an electronic file.

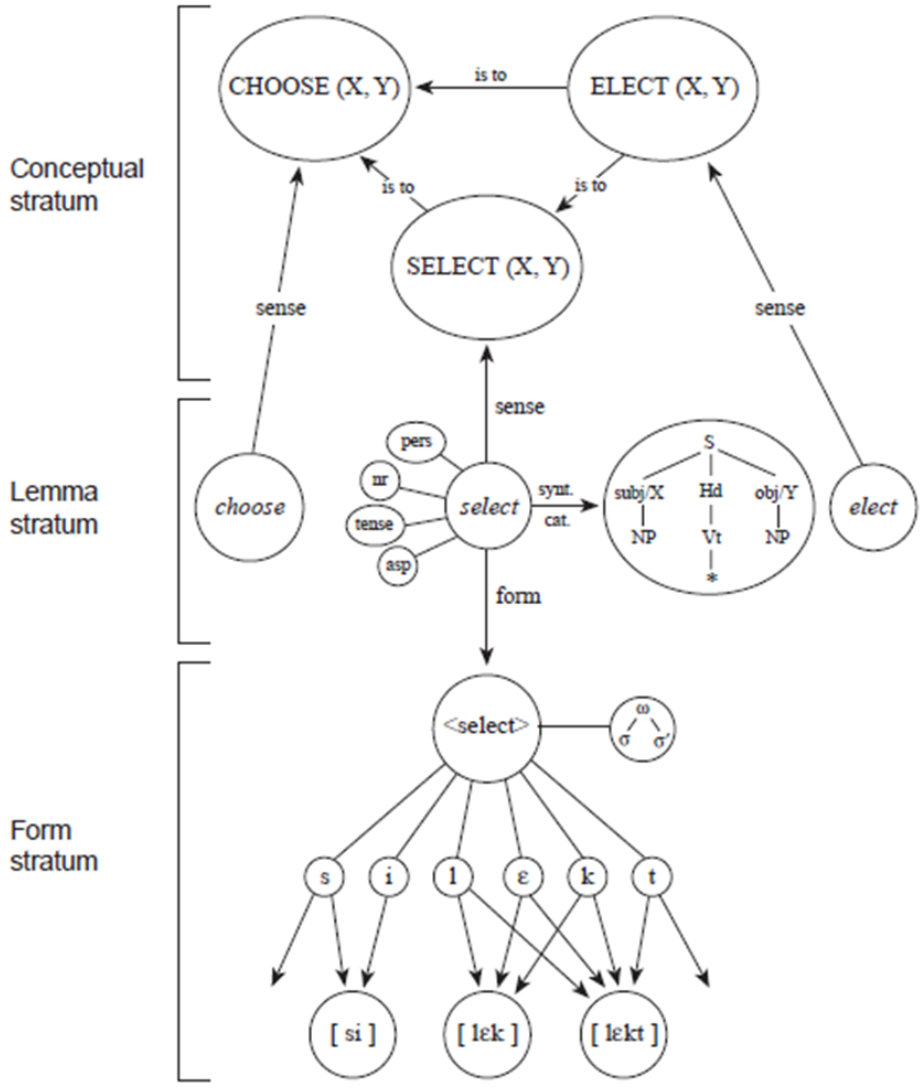
2. Theoretical background

We call speech to the staged process throughout which we can express our feelings or ideas. To perform a word, as it is a meaningful component of speech, it is necessary to associate it with a lexical concept, a process called conceptual preparation (Levelt, Roelofs and Meyer, 1999). Then, each concept is linked with a word or a so-called lemma. To do that, it is necessary to have a lexical selection throughout which we retrieve a lemma from our lexicon. As our lexicon stores thousands of words, the selection of that lemma depends on the context and on the decision-making process of the speaker (Butterworth, 1994); (Levelt, 1999). When doing this selection, the speaker may retrieve two or three lemmas, and will finally select the most activated one according to the concept and the lemma's frequency of use. When getting a

lemma, the speaker also retrieves its group of diacritic parameters, which must be set for a proper realization of the word, for example the transitive or intransitive feature of a verb (Levelt et al., 1999).

After getting the lemma and its parameters from the lexicon, it is time to encode what has been being processed in previous stages into a language container. In order to do this, the speaker firstly looks for the proper phonological realization of the word, retrieving from the lexicon the morphophonological coda of the lemma. It is there; where syllabification takes place. Subsequently, the phonological coda is to be produced, and for this purpose, the phonetic realization and the prosodic features of the sounds will be recovered from the mental lexicon. Finally, this is sent to the articulatory system and the vocal tract produces the word (Blumstein,1994); (Levelt et al.,1999).

Figure 1. **Word selection process (Levelt, 1999)**



This is depicted in figure 1 where the process throughout which a speaker produces the word *select* is represented. Firstly, the speaker is looking for a word that covers the meaning of *choosing* or *selecting*. Then he recovers the lemma *select* form his lexicon, accompanied by its diacritic parameters such as the type of verb, in this case a verb selecting two internal arguments. Hereafter, the lemma has to be linked with the phonemic coda, */s/*, */ɪ /*, */l/*, */ɛ/*, */k/*, */t/*, which is stored in the lexicon. Finally, the syllabification process takes place and it clusters the phonemic elements into *[sɪ]*, *[lɛkt]*, which are the sounds that the speaker actually produces.

Any damage or disorder in the network could affect the production or perception of speech, as it happens to aphasic speakers (Butterworth, 1994), the participants that constitute the focus of the present study.

2.1. On aphasia

Aphasia is a language impairment originated by an acquired lesion in any part of the brain responsible for language (Ahlsén, 2006); (Danca, 1946). The most common cause of aphasia is a stroke in the left hemisphere, area in charge of language. The stroke produces a brain damage which makes neuronal intercommunication not possible.

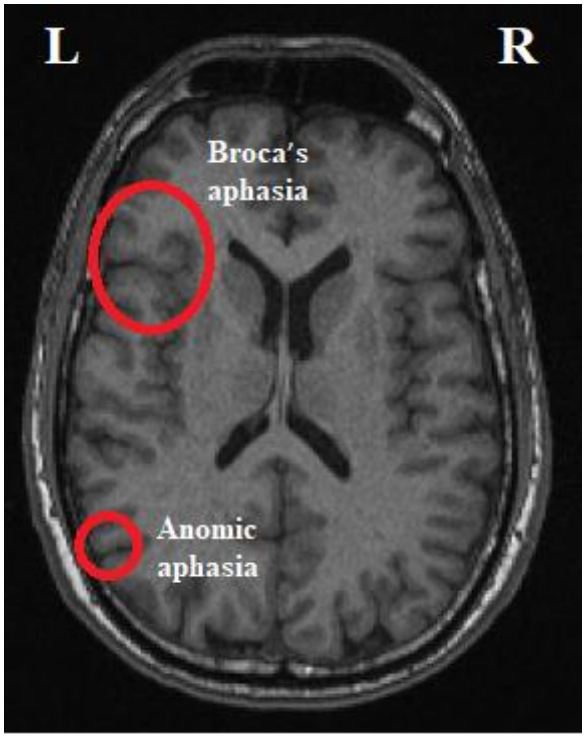
There are different types of aphasia depending on the area of the brain being affected (Norman and Baratz, 1979). People suffering from aphasia struggle in one language mode or another: either production, comprehension or articulation (Ahlsén, 2006); (Medeiros, Rissoni, Santana and Ishigaki, 2016); (Roby-Brami, Hermsdörfer, Roy and Jacobs, 2012). This gives way to different types of aphasia.

There are several classifications into which the different aphasias could be organized. One of them classifies aphasia into two groups: fluent and non-fluent aphasia (Butterworth, 1994). As their names denote, this subdivision deals with the fluency of the aphasic speakers' speech. Within this classification, there is another subdivision into two major types of aphasia: receptive and expressive. Receptive aphasia is characterized by affecting the comprehension of language in any of its ways, either listened or read; while in speakers with expressive aphasia spoken and written language is altered (Danca, 1946). In consonance with these classifications, there are different types of aphasia. In this study the focus is on Broca's and anomic aphasias and, therefore, these will be described next.

Both Broca's and anomic aphasias are expressive aphasias. Therefore, people who suffer from this impairment have deficits in their speech production. On the one hand, Broca's

aphasia takes its name because of the affected area: Broca's area. This area is the one in charge of codifying speech and sending it to primary cortex to be pronounced (Norman and Baratz, 1979). On the other hand, in anomic aphasia the injured region is not always the same, although it is usually closed to a language area but, as Goodglass (1980) established, "the lesion site most frequently associated with anomic aphasia is the temporal-parietal junction" (p. 648). The affected areas in each type of aphasia are marked in figure 2.

Figure 2. **Affected areas in Broca's and anomic aphasias**



In the magnetic resonance of the brain in figure 2, a stroke in any of these areas would be reflected in a darker space in the image in these areas because of their disuse.

Although both aphasias disturb the expressive function of language, there are differences in how speech is altered. That inequality is due to the fact that the affected area of the brain is not the same in Broca's and anomic aphasias. On one side, Broca's aphasia gives way to non-fluent speech (Ahlsén, 2006), and therefore, speakers with Broca's aphasia are difficult to understand. On the other side, anomic aphasia is characterized by fluent speech.

However, although word production is larger, what is communicated is more difficult to understand. Sometimes, anomic aphasics are not able to transmit any message. However, it may be remarked that not all speakers, although they had the same diagnosis, present the same symptoms (Butterworth, 1994).

2.1.1. Broca's aphasia

Broca's aphasic speakers do not have problems in comprehending single words and short sentences, but their comprehension of long, complex structured sentences is impaired. In addition, their speech is laboured and incomplete, as in (1), composed by simple and formulaic expressions with short structures, as in (2), often ungrammatical, as in (3), and full of repetitions, as in (4). Therefore, their use of language is unproductive.

(1) PAR: hm (.) I would &-uh &-uh +...

(2) PAR: I don't know

(3) *PAR: **and they** [//] &-uh oh **the** &-uh &+haw &+hos &+hos hɔtəl@u **[:hospital]** [* n:k] [//] &+hos &+haw &+haw &+haw &+haw hɒtləs@u [:hospital] [* n:k-rep] [/] &+hot hɒtləs@u [: hospital] [* n:k]

(4) PAR: &-um (..) ball [/] &=ges &=points:panel1 ball [/] ball [//] the ball

(Fridriksson Corpus, 01)[1]

Speakers with Broca's aphasia have slow production because they struggle to find the precise word. They have word finding problems and object naming difficulties (Holland,

[1] Most of the examples in the present undergraduate dissertation are taken from the Aphasia Bank in TalkBank and are, therefore, in CHAT format. The access to Aphasia Bank is restricted to clinicians and investigators (https://aphasia.talkbank.org/) and so the author of the present study has received explicit permission to use these data. In order to comply with the specific ground rules of the Aphasia Bank, and in order to identify the participants, we cannot indicate the names of the files that have been used in the present study. Therefore, at the end of each example, the corpus from which the example has been extracted will always appear. In this case, for instance, the examples are taken from the Fridriksson Corpus. The name of the file used correspond to the name given by us which does not coincide with the actual name of the file in the corpus.

2008); (Kent, 2003), as illustrated in (1), which makes their speech be full of hesitations and stuttering. They use grammar suffixes incorrectly, and they do a lot of word repetitions, especially in spontaneous speech (Ahslén, 2006); (Butterworth, 1994), as it happens with the word *ball* in (4). However, their speech is more meaningful than that of fluent aphasics (Blumstein, 1994). As Butterworth (1994) established "patients try to produce just those words that give the highest information yield, usually nouns" (p. 56). These symptoms are due to the function of Broca's area: speech production and articulation.

2.1.2. Anomic aphasia

Conversely, anomic aphasic speakers do comprehend, but their production, although grammatical, is marked by word-finding difficulties and a lot of circumfluences[2], as they have many problems in finding content words, such as in naming objects situations (Glezerman and Balkoski, 1999); (González and Hornauer-Hughes, 2014); (Holland, 2008). However, it may be remarked that authors like Holland (2008) and Kent (2003) consider this type of aphasia less severe than other aphasias as word-finding difficulties are common in every aphasic speaker.

Anomic speakers' oral production is characterized by the correct use of syntax and the use of complex sentences (Kent, 2003); (Pulvermüller, 2003), as in (5)

(5) PAR: good compared to what it was before

(Fridriksson Corpus, 01)

In (5) it can be seen how the anomic aphasic makes a proper use of syntax, by using not only simple structures but embedded sentences. He also uses a circumfluence using a detour saying "what it was before" instead of explaining how it actually was. This serves to support

[2] A circumfluence consists of doing a detour when speaking instead of producing the exact word.

the idea of how difficult it is for anomic aphasics to find content words. Therefore, their speech does not often transmit a great amount of content. In fact, anomic aphasics' speech has low burden in terms of semantic content, with the frequent use of generic and imprecise words such as "thing", which make them create grammatical sentences but with low semanticity. Their production typically shows logorrhea, an excessive and disordered use of words. Due to their inaccessibility to the meaning of some words, their speech is characterized by the use of verbal paraphasias, where the verb is substituted by another phonetically similar one, as in (6): *bought* is used instead of *brought*. Another feature of anomic aphasics' speech is the use of literal paraphasias where the substitution is made in terms of sound similarity (Blumstein, 1994), as in (7), where the speaker makes up a word with a phonetic realization similar to *still*.

(6) PAR: and they bought [: brought] [* p:w] my dog up

(7) PAR: and &-um I [//] I'm tsɪl@u [: still] [* p:m] friends with them

(Fridriksson Corpus, 02)

This kind of speech is classified by Butterworth (1994) as paragrammatic and he points that "the lesions responsible for paragrammatic speech are found in the posterior language regions, Wernicke's area" (p. 56). That is why the use of neologisms and jargon is shared by Wernicke's and anomic aphasics, as both have a paragrammatic speech.

Paragrammatic speech can be analysed from different points of view. One of them is semantics. In order to address the semantics of paragrammatic speech, the present dissertation focuses on the aphasics' production of DPs and on the theta roles (or thematic roles) these DPs are assigned by verbs.

2.2. On theta roles

The composition of a sentence depends on its verb's subcategorization frame. From the point of view of syntax, it is the verb which determines which arguments (compulsory elements) and complements (optional elements) appear in the sentence structure.

For instance, in the case of a transitive verb, both a subject and a direct object are subcategorized by the verb. If a transitive verb lacks any of these arguments, the sentence will be ungrammatical. The form an argument takes in a specific construction is also linked to its syntactic function, as illustrated in (8) (Haegeman and Guerón, 1999).

(8) a) Louise abandoned the project

b) *Louise abandoned

c) *Louise abandoned after the project

(Haegeman and Guerón, 1999)

In sentence (8a) it is shown that the verb *abandon* requires a DP functioning as a direct object. If this verb does not have such an argument (8b) or if it has a different form, for example a Prepositional Phrase (PP) (8c), the sentence will be ungrammatical. Therefore, the type of argument required (both formally and functionally) would be determined by each verb (ibid.).

From the point of view of the semantic analysis, the structure of a sentence also depends on its verb and, in particular, on the type of semantic relations that the verb imposes on the arguments it subcategorizes. That is, apart from having a syntactic function and a particular form, arguments have a semantic burden. In fact, the selectional requirements of a verb are meticulously related to its meaning in a way that, depending on the verb, one type of argument or other would be required. The semantic relationship between verbs and its arguments, is captured by means of different thematic roles, also known as theta roles (ibid.). Theta roles are

the labels assigned to the set of thematic relations associated to a DP in consonance with its relationship with the action of the sentence. Moreover, as Chomsky (1993) stated in the theta criterion, theta roles can only be assigned to existent arguments of the sentence because of their one-to-one relationship. That is, each argument will have just one theta role assigned and each theta role will be assigned to a unique argument in the same sentence.

(9) Thelma abandoned the project
1 2

(Haegeman and Guerón, 1999)

In (9) the verb *abandon* requires two arguments: the person who abandons and what is being abandoned. In this case, argument 1 is the one who abandons, so it is the agent of the action, while argument 2 represents what is being abandoned, and it is the patient of the action. These are the required theta roles by the verb *abandon*. However, there are more types of theta roles. Out of the different classifications, the one that has been used for this study is Haegeman's (1994).

As stated in Haegeman's classification of theta roles, there are eight categories. Firstly, she refers to agent as the doer of the action, and patient as the person or thing that is experiencing the action, as it has been analysed in example (9). The person or thing that is moved by the action is called theme. An example of this appears in (10), where *the ball* is the entity moved or affected by the action of the verb *pass*. Experiencer is the role assigned to the entity which experiences an action or state but not voluntarily, as in (11), where the subject is not developing the action voluntarily, but experiencing it. Goal is used to refer to the entity towards which the activity is directed, which is not necessarily a place, and so it can also be a thing or a being, as in (12). Beneficiary theta role refers to an entity that takes profit from the action, as *me* in (13), which is the referent that benefits from the action, in this case, the one who was given the present. The theta role source refers to the entity from which something moves because of the action, that is, the starting point of that action, as *the park* in (14). The

last theta role in Haegeman's classification is location. It refers to the place where the action is situated, as in (15).

(10) John passed the ball

(11) He felt ill

(12) You handed the book to Louise

(13) He gave me a present

(14) My dad is coming from the park

(15) They live in this house

Taking into account the different theta roles presented above, it may be highlighted that theta roles are not always assigned by verbs. They can also be assigned by an adjective in Saxon Genitive case, and by a preposition (12, 14 and 15). However, in the present study, only those assigned by the verb will be considered.

As referred to above, the form of DPs is relevant for theta role assignment (Saffran, Schwartz and Linebarger, 1998); (Shapiro and Thompson, 2006); (Thompson, Shapiro, Li and Schendel, 1995). DP forms include pronouns (11 and 13) and full DPs (10,12,14 and 15). By analysing theta roles, it can be seen whether language production is correct from both a syntactic and a semantic perspective.

Theta roles have a semantic relationship with the verb but, as they are assigned to DPs, a syntactic relationship is also instantiated between the DP and the verb. Therefore, it is not uncommon to think that each role is typically assigned to the same syntactic function most of the times. This predisposition of theta roles to be assigned to specific syntactic functions leads to consider some preconceptions. Thus, Carlson and Tanenhaus (1988) establish "a set of mild expectations about which thematic roles the verb, when encountered, will actually assign" (p. 287). According to their statements, the DP which precedes the verb is usually the subject

(function) and the agent (theta role), and the one which follows it is either the direct object (function) and the theme (theta role), in the case of transitive verbs, or, in the case of state verbs, the subject complement or adjunct (function) and the patient (theta role).

(16) a) Peter is eating an apple

b) An apple is being eaten by Peter

Therefore, typically developed speakers will produce sentences like (16a), in which the DP preceding the verb *Peter* is the subject (function) and the agent (theta role), and the DP following the verb *an apple* is the direct object (function) and the patient (theta role). However, if the voice of sentence (16a) is changed and it is turned into passive (16b), these preconceptions are not followed because now, the DP preceding the verb *an apple* is still the subject (function), but patient (theta role). Then, the order of DPs within the sentence changes because of movement, but the theta role assigned to each DP is still the same as theta role assignment happens prior to movement.

The assignment of theta roles may suppose a problem to aphasics as will be explained bellow.

3. Previous empirical studies on aphasics' language

As Saygin, Wilson, Dronkers and Bates (2004) argue, "aphasia is not a specific-domain disorder" (p. 1799). As the focus of the present dissertation is the language of aphasics, this section will refer to previous empirical studies on aphasics' different linguistic aspects. First, Saygin et al.'s study (2004) and its results on aphasics' linguistic and non-linguistic comprehension will be dealt with; second, Shapiro, Gordon, Hack and Killackey's study (1993) and the results from testing typically developed participants, Broca's and Wernicke's aphasics sensitivity to thematic properties of verbs will be addressed; and third, the results obtained from

Whitworth's study (1995) will be considered by examining theta roles in the spontaneous output of anomic aphasics.

Throughout several tasks, Saygin et al.'s study (2004) analyses aphasic speakers' deficits which deal with linguistic and non-linguistic comprehension. Although the objectives of the study belong to the clinical domain, linguistics occupies a great part of the study because speech deficits' treatments should not depend only on medical therapies but also on linguistics analyses and the subsequent linguistic intervention. Even if aphasics show both linguistic and non-linguistic deficits in an uncorrelated way, deficits are more severe in the linguistic domain. This study supports that aphasics, especially those with non-fluent speech, have a greater deficit in linguistic (reading) rather than in non-linguistic comprehension (pantomimed actions). However, reading and pantomimed actions' comprehension are not coupled processes. And, when talking about reading comprehension deficits (linguistic domain), the affected areas of the brain are the same that hinder sentence processing, phonological processing and articulation.

Shapiro et al.'s (1993) study deals with typically developed, Broca's aphasics and Wernicke's aphasic[3] participants and it tests their sensitivity to thematic properties of verbs in specific sentence types (i.e. active, passive, cleft-subject and cleft-object). Regardless of the sentence type, Broca's aphasics and typically developed participants are sensitive to verbs' thematic properties, while Wernicke's aphasics do not have sensitivity to this property. This points to important differences across the different types of aphasia when it comes to linguistic analysis.

On the one hand, this study suggests that the difficulties that Broca's participants encounter to access semantic and thematic information is independent from those encountered

[3]Wernicke's aphasics are characterized by their fluent speech.

when dealing with complex sentence comprehension. However, this statement could be clouded because, although the time of accessing thematic and semantic information is on average, they have difficulties in transmitting and structuring this information properly within the sentence. Therefore, the time of producing such utterance is higher when compared to that of typically developed participants.[4]

On the other hand, Wernicke's aphasic participants show no distinction between verbs with different thematic representations. As thematic information is part of the lexicon conceptual structure, Shapiro et al. suggest that this lack of sensitivity could be due to a disorder in representing lemmas or in accessing this kind of information.

Whitworth (1995) develops two assessment tools in order to study anomic aphasics' theta role' assignment. One of these tools contrasts the retrieval of elicited single-words and sentence contexts; and the other one allows the examination of theta roles realization in spontaneous output.

In her study, anomic participants speech is characterized by the production of structures where only one theta role needs to be realised. However, two-argument sentences are usually unfinished and, therefore, no theta roles are realised. Thus, the participants show their difficulties in producing complex sentences such as three-argument or thematic embedding sentences. Consequently, their speech suffers a reduction in terms of sentence complexity and a somehow high proportion of incomplete sentences which is characteristic of word retrieval deficits, and, in turn, it is related to theta role assignment.

In summary, the empirical studies analysed above provide information of Broca's and anomic aphasics' language production and comprehension which is useful for the present study

[4] This information, according to Shapiro et al., may be useful for further treatment programs of speech production and comprehension.

as the target population is the same. Moreover, information on Wernicke's aphasics can also be advantageous when compared to anomic aphasics, as speakers suffering from both types of aphasias are characterized by their fluent-speech.

4. Research questions

The research questions that guide this study are established in this section according to what has been presented in sections 2 (theoretical background) and 3 (empirical studies). These questions will be related both to Broca's and to anomic participants as the production of one Broca's participant and that of an anomic participant will be analysed. Question set 1 focuses on the form of arguments bearing theta roles; question set 2 on the function of arguments bearing theta roles; and question set 3 on theta role assignment.

4.1. Question set 1: arguments' form

4.1.1. Do aphasics produce arguments of a specific form?

Following Levelt et al. (1999), the more common the word is, the easier it will be activated. Therefore, as aphasics have word finding difficulties, both anomic and Broca's aphasics are expected to produce more pronouns than full DPs; that is, they will use more pronouns as they are easy to retrieve when compared to retrieving the specific DP they are referring to.

4.1.2. Do Broca's and anomic aphasics produce arguments of a specific form?

Following Blumstein's (1994) statement that Broca's speech is more meaningful than that of anomics, Broca's participant is expected to produce more full DPs, and the anomic participant is expected to produce more pronouns in his speech.

4.1.3. Are theta roles associated to a specific form?

Although agents and beneficiaries are expected to be produced as pronouns due to their personal referentiality; patients, themes and experiencers are supposed to be more specific and to be assigned to full DPs.

4.2. Question set 2: arguments' function

4.2.1. Do Broca's and anomic aphasics produce specific functions to a similar extent?

They are expected to produce a similar rate of subjects and direct objects, because the argument structure depends on the verb. However, bearing in mind Whitworth's empirical study, the anomic participant is not expected to produce a great number of indirect objects, but still a higher percentage when compared to that of Broca's participant.

4.2.2. Are theta roles associated to a specific DP function?

Following Carlson and Tanenhaus (1988), the associations that are expected in this case are the following: agent is expected to be the syntactic subject realised by a pronoun; patient, theme and experiencer are expected to be full DPs with direct object function; and beneficiaries full DPs syntactically functioning as indirect objects. These associations are awaited to be found in the data under analysis in this dissertation. Regarding goal, location and source, as these theta roles are typically assigned by prepositions, no instances are expected to be found.

4.3. Question set 3: theta role assignment

4.3.1. Do Broca's aphasics produce structures in which with theta role assignment is complete?

Following Chomsky (1993) and Butterworth (1994), theta roles and arguments have a one-to-one relation. Given that Broca's speech is incomplete, theta role assignment is not expected to proceed fully.

4.3.2. Do anomic aphasics produce structures in which with theta role assignment is complete?

Bearing in mind Blumstein (30), as anomic speech is grammatical and follows an appropriate argument structure, the anomic participant is not expected to leave theta roles unassigned.

5. Methodology

In this section, the methodology followed in the present study is outlined. This involves information on the participants selected as well as on the processes of data selection and data classification. Also, some data have been discarded and the motivation for this is explained too.

5.1. Participants

Two age-matched monolingual aphasic speakers from the USA have been selected for the analysis, each one with a different type of aphasia: anomic and Broca's aphasia. In both cases, participants show a language impairment due to an acquired stroke in the brain. These participants are two of the subjects studied by Fridriksson's Aphasia Lab of the University of South Carolina, and they are included in the Fridriksson Corpus which is part of the Aphasia Bank in TalkBank (MacWhinney et al., 2011)

Table 1. **Participants' profile**

Participant	Corpus[5]	Sex	Age	Type of aphasia	MLU
A	Fridriksson	Female	58;03	Anomic	7.456
B	Fridriksson	Male	55;04	Broca's	2.339

[5] Access to the corpus from which the data have been taken is restricted. We have obtained explicit consent from Brian MacWhinney and Davida Fromm to access these data and analyse them. We would like to thank them for it. In order to deidentify the participants, some information cannot be disclosed and this involves, for instance, the name of the files analysed. That is why this information does not appear in table 1.

As can be seen in table 1, the participants are a 58-year-old female anomic aphasic speaker and a 55-year-old male Broca's aphasic speaker. Each participant has been selected from a group of aphasic speakers who have the same type of aphasia. The selection criteria for choosing these participants are following: first, one participant from each aphasia type is necessary in order to be able to address the three research questions stated in the previous section, that is, in order to compare the production of participants with these two aphasia types; second, participants' age needs to be similar as age differences can affect production; and, third, a representative participant from each group is selected in the sense that each participant's production needs to be representative of his/her aphasia type in terms of overall linguistic production. This results in an anomic aphasic speaker with an average Mean Length of Utterance (MLU) of 7.456; and a Broca's aphasic participant whose MLU is 2.339. This MLU difference is, of course, expected given the different brain areas affected in each aphasia type and the different implications this has for the speakers suffering from these aphasia types (see section 2.1. above).

5.2. Data selection

The necessary data for the present study have been extracted from the Aphasia Bank. This bank is formed by several corpora with records from different aphasic speakers. It includes multimedia content like video and audio records but also their corresponding written transcriptions which is what has been analysed in the present dissertation.

The data for this study have been taken from the Fridriksson Corpus in the English-Aphasia folder. The main criterion for selecting this corpus has been that the data have been elicited by making the participant perform tasks associated to different competences; as well as the parallelism between the way the data have been elicited for the two participants selected

for the present study. Therefore, because these variables are kept constant, any difference in the results could actually be attributed to the speakers' aphasia type rather than to differences in the circumstances in which the data have being elicited. Sex differences have been shown not to affect adult participants' production and so this was not considered as a variable in the present study.

The procedure followed for the data collection has been the following in both cases. First, the participants have been asked about what their speech looks like. Second, they have had to tell as much as they know about their stroke. Third, they have been asked to tell an important event of their lives which have been important to them. Fourth, the investigator has shown some pictures that represent a story to them, and they have had to describe these by making a structured story with a beginning, a middle and an end. Finally, only in the case of the anomic aphasic, there is an extra task, a storytelling task. For this, the investigator has provided a tale to the participant and has let her read it for some minutes. Then she has had to retell the story using what she had just read and her own knowledge. Probably, this last task has not been performed by Broca's participant in the selected record because of time limitations. Researches have established a maximum duration for the interviews (a common practice in these studies) and, as Broca's aphasics' speech is not fluent, the participant's latency is more elevated than that of the anomic participant (Milberg and Blumstein, 1981).

In the case of the grammatical analysis, data have been selected as follows, both in the case of verbs (theta role assigners) and DPs (theta roles receivers). In the case of verbs, firstly, as this study deals just with the theta roles assigned by verbs, the unit of analysis is the sentence. In addition, only clauses with lexical verbs are considered, because auxiliary and copula verbs either do not assign theta roles or their theta role assignment properties are not complete. Also, only clauses with inflected verbs are part of the study because verbs in non-finite form have

their capacity to assign theta roles cancelled or partially cancelled. That is, the unit of analysis is the sentence that contains an inflected lexical verb.

In case of DP arguments, first, only arguments receiving theta roles from verbs are considered. Second, only arguments functioning as subjects, direct objects or indirect objects are part of the analysis, as adjuncts' theta roles are typically assigned by a preposition. Third, only overt DPs are analysed, both full DPs and pronouns. There are different criteria that have been followed to discard cases that, even if they comply with the selection criteria above, presented some problems.

Taking the criteria above into account, for a more precise analysis, three cases have been discarded, all of them produced by the Broca's participant. Cases like those in (17) and (18) have been discarded because the word that the participant says has not been recognised by the person who has transcribed it, so it is not known if the unrecognizable DP has received the proper theta role. Therefore, the theta roles assigned to those words cannot be labelled.

(17) PAR: &=points:panel3 xxx sit [x 3] [//] sits

(18) PAR: &=points:panel2 xxx looks around

(19) PAR: &=points:panel5 and the &-uh wife &+w wɑs@u [: x@n] [* n:uk-ret] [//] &+w &+w wash [//] watch

(Fridriksson Corpus, 01)

Cases like that in (19) have been discarded because there are two verbs. This is due to the difficulty that aphasics have to find the proper phonetic realization of some words. When this happens, the speaker usually produces several words phonetically similar but with different meaning. Therefore, as each verb has a specific theta role assignment pattern, choosing one verb over the other can bias the study. In (19), the verbs *wash* and *watch* have different argumental structure; and although both verbs must have an argument which is agent (theta

role) and subject (function) and both have an argument which is object (function), the theta role of the object is not the same for both verbs.

The discarded cases have not been taken into account for the data classification that will be presented in the next section.

5.3. Data classification

An Excel spreadsheet has been used to classify the data fulfilling the criteria above. The data have been classified in five spread sheets as they appear in the corresponding database supplied in the CD attached to this disssertation.

The database includes three different types of information: a first block includes general data of the participants' overall verbal production (MLU value, number of items used, number of tokens, number of utterances, number of sentences analysed and overall number or theta roles analysed); a second block includes more specific verbal information (number of theta roles per sentence, type of theta role, correctness, DP form and DP function). The third block includes the actual counting of the data as per the information in the second block. This comprises three tables that combine the three grammatical properties under consideration (i.e. theta role, form and function). The first table deals with form and theta roles; the second deals with function and theta roles; and the third, with form, function and theta roles.

The information of the first block is provided in table 2 as an example of what the database looks like. In it, general data from both participants are classified to get an overview of the speech properties of these two participants. Their MLU is indicated to show an average of the words produced per utterance. To show the semantic burden of their speech, the items used and how many times they use them (tokens) have been counted. Then, the number of utterances produced in their speech and those which have been analysed (number of clauses) are included in the table to illustrate the amount of production that is relevant for this study.

Also, the number of theta roles assigned by verbs to arguments is indicated in order to see how many arguments have been analysed.

Table 2. **Participants' overall verbal production**

	MLU	**Items used**	**Tokens**	**Number of utterances**	**Number of clauses**	**Number of theta roles analysed**
Anomic	7,456	306	1051	162	135	180
Broca's	2,339	112	320	154	20	13

The second block contains the actual classification of the data targeted in the present study. Table 3 shows how every sentence has been classified. When the sentences have been included in the database (table 3, section 2), they have been cleaned up by deleting the repetitions and stuttering. If sentences contain paraphasia, the word considered has been the one which is meant to be said (it is usually identified by the person who has transcribed the recordings) as *brought* in (6).

(6) *PAR: and they bought [: brought] [* p:w] my dog up

The number of theta roles of each sentence has been indicated (table 3, section 3). Each of them has been classified separately showing its type (table 3, section 4) according to Haegeman's classification of theta roles; whether the given argument has been assigned its theta role correctly (right (R)) or incorrectly (wrong (W)) (table 3, section 5); whether the argument form is a pronoun or a full DP (table 3, section 6); and whether the argument function is subject (S), direct (DO) or indirect object (IO) (table 3, section 7).

Table 3. **Data classification of the participants' verbal information**

1. Speaker		Anomic
2. Sentence		we built a house
3. Number of Theta Roles		2
Theta Role 1	4. Type	Agent
	5. Correctness	R
	6. DP Type	Pronoun
	7. Function	S
Theta Role 2	Type	Patient
	Correctness	R
	DP Type	full DP
	Function	DO
Theta Role 3	Type	--
	Correctness	--
	DP Type	--
	Function	--

This data classification leads to the third block and allows to organize the data in three different ways for the subsequent analysis. First, putting in common theta roles and form, as in table 4; second, theta roles and function, as in table 5; and third, theta roles, function and form, as in table 6.

Table 4 shows the classification of DPs receiving in this case the agent theta role. Table 5 shows the classification of arguments receiving in this case the agent theta role in terms of syntactic function. This information is analysed for both participants and for each theta role type.

Table 4. **Classification of DPs receiving agent theta role in terms of form**

	Agent	
	Pronoun	**Full DP**
Anomic	64	12
Total number of arguments	76	
Broca's	4	1
Total number of arguments	5	

Table 5. **Classification of DPs receiving theta role in terms of function**

	Agent		
	Subject	**DO**	**IO**
Anomic	76	0	0
Total number of arguments	76		
Broca's	5	0	0
Total number of arguments	5		

Finally, the classification that takes into account the three different variables (i.e. theta roles, form and function) is illustrated in table 6. These variables are associated in the way table 6 shows, that is, each theta role, agent in this case, is divided according to its syntactic function, and in turns, each function is classified in terms of the form playing the said function.

Table 6. **Classification of form and content of DPs receiving agent theta role**

			Anomic	**Broca's**
Agent	**Subject**	**Pronoun**	64	4
		Full DP	12	1
	Direct Object	**Pronoun**	0	0
		Full DP	0	0
	Indirect Object	**Pronoun**	0	0
		Full DP	0	0
	Total		76	5

This data classification allows the organization of the information in different ways so as to give response to the initial research questions formulated.

6. Results and discussion

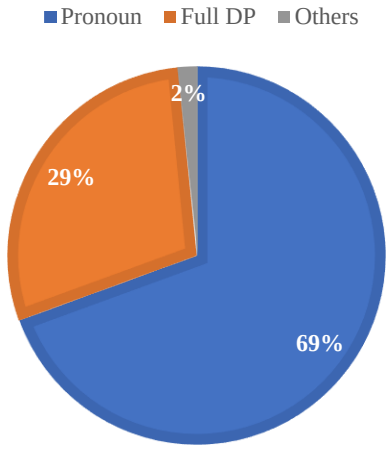
In this section, the results obtained from the present study and how they provide an answer to the research questions established is discussed. Firstly, the form of arguments produced by aphasics is discussed; afterwards, the function of arguments; and finally, the correctness of theta roles.

6.1. Question set 1: arguments' form

6.1.1. Do aphasics produce arguments of a specific form?

Considering the data analysed, aphasics produce more pronouns than full DPs, as represented in figure 3. The DPs produced by the participants are 69% pronouns (134 cases) and 29% full DPs (56 cases) as the words used in a higher frequency are easily retrieved (Levelt et al., 1999) and, therefore produced. A 2% (3 cases) of the analysed arguments take a different form which has not been considered for the present study, that is, wh-pronoun. However, it is surprising to find wh-movement or relatives, because, as previously explained, aphasics are not supposed to produce such complex structures.

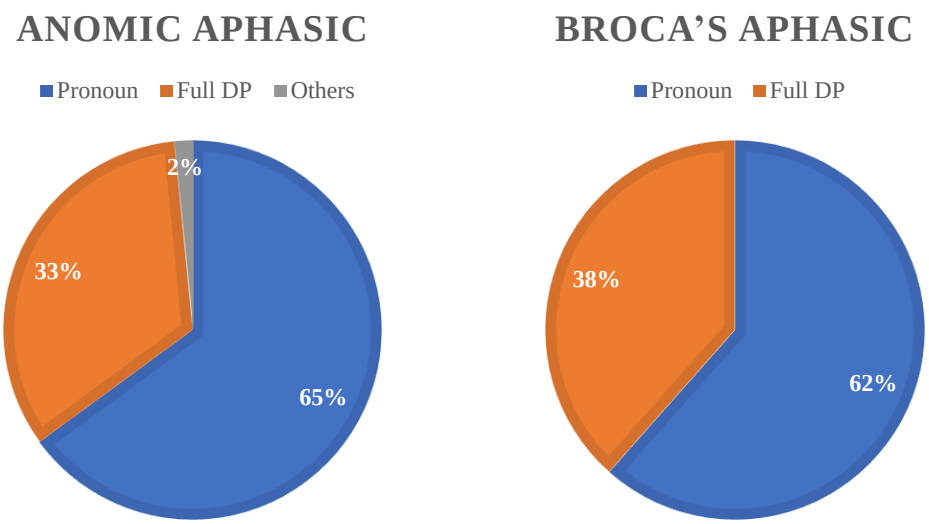
Figure 3. **Participants' production of DPs**



6.1.2. Do Broca's and anomic aphasics produce arguments of a specific form?

It was expected for Broca's participant to produce more full DPs; and for the anomic participant to produce more pronouns in her speech. However, both produce more pronouns than DPs. As seen in figure 4, the results obtained in the case of Broca's and anomic aphasic participants are not very different, which can be interpreted as Broca's having higher difficulty than expected in accessing words with high semanticity.

Figure 4. **Participants' production: form**



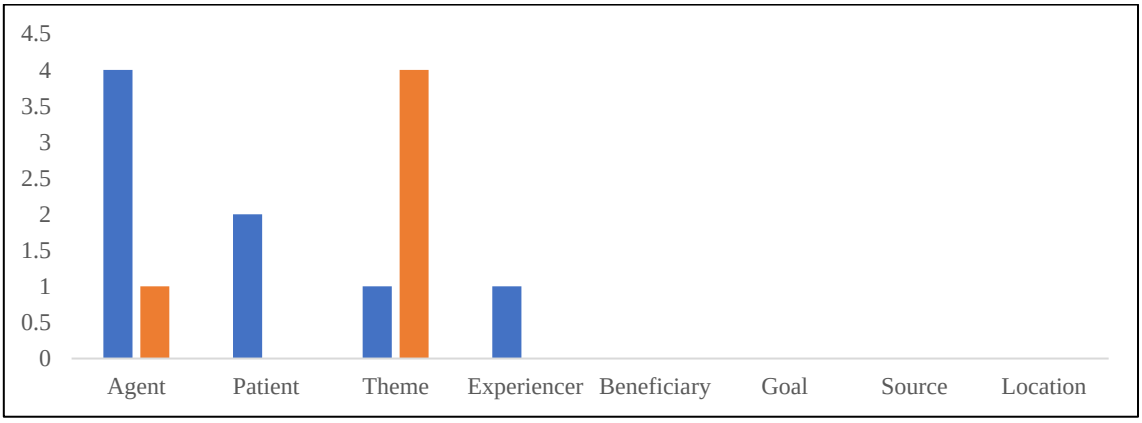
6.1.3. Are theta roles associated to a specific form?

For this question different results have been obtained depending on the theta role type. On the other hand, regarding agents, 84% (68 cases) of the agents produced are pronouns; and in beneficiaries, only pronouns are produced. On the other hand, patients are produced as full DPs in 44% of the cases (7 cases) and experiencers in 15.5% (7 cases); only themes are mostly produced as full DPs (69%, 29 cases). Yet, results have been analysed separately for each participant.

6.1.3.1. Broca's aphasic's production

As figure 5 shows, Broca's participant's production is in tune with what was expected regarding the form of agents, as he produces mostly pronouns. However, there are no instances of beneficiaries in Broca's production, nothing can be said in this case for the beneficiary theta role. In the patient role, only pronouns are produced, while themes are mainly realised by full DPs. These results offered mixed effects with the respect to the results we expected to get.

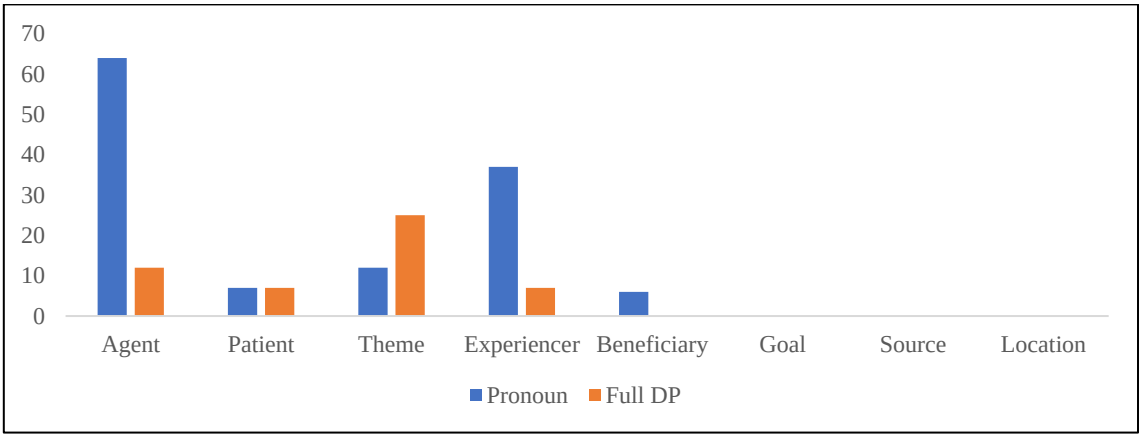
Figure 5. **Broca's aphasic's production: theta role and form**



6.1.3.2. Anomic aphasic's arguments production

As shown in figure 6, the results obtained are similar for Broca's and for the anomic aphasic participants. As predicted, agents and beneficiaries are most produced as pronouns. However, the pronoun form is the most common form produced in all theta roles, except from themes, which are mostly realised as full DPs. Therefore, in the anomic participant the predictions are met in the case of agents and beneficiaries being mostly produced as pronouns, and themes mostly realised as full DPs.

Figure 6. **Anomic aphasic's production: theta role and form**



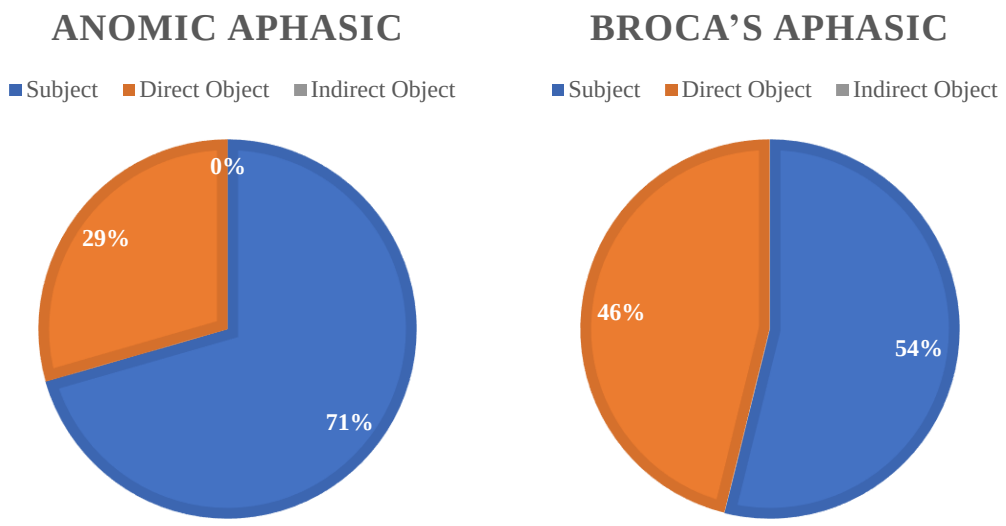
6.2. Question set 2: arguments' function

6.2.1. Do Broca's and anomic aphasics produce specific functions to a similar extent?

As presented in figure 7, both Broca's and the anomic aphasics produce more arguments as subjects than those produced as direct objects. This is a reflection of verbal argument structure and of the fact that their speech is known to be incomplete as a consequence of word retrieving difficulties.

Regarding functions produced by Broca's aphasic participant, the difference between subject and direct object production is very little (8%). The reason for this, as established in previous sections, is that Broca's aphasics are sensitive to thematic properties of verbs. Therefore, they try to make sentences with the required arguments, although they are sometimes not grammatically correct. Regarding functions produced by the anomic aphasic participant, subjects are produced at a higher rate (71%, 127 cases), as subjects are compulsory elements when dealing with conjugated verbs in English.

Figure 7. **Participants' production: function**



Therefore, although both participants were expected to produce a similar rate of subjects and direct objects, only Broca's participant follows the expectation. On the other hand,

none of them produce indirect objects. Thus, the initial idea that Broca's would produce less indirect objects than the anomic speaker is not supported by the data analysed here.

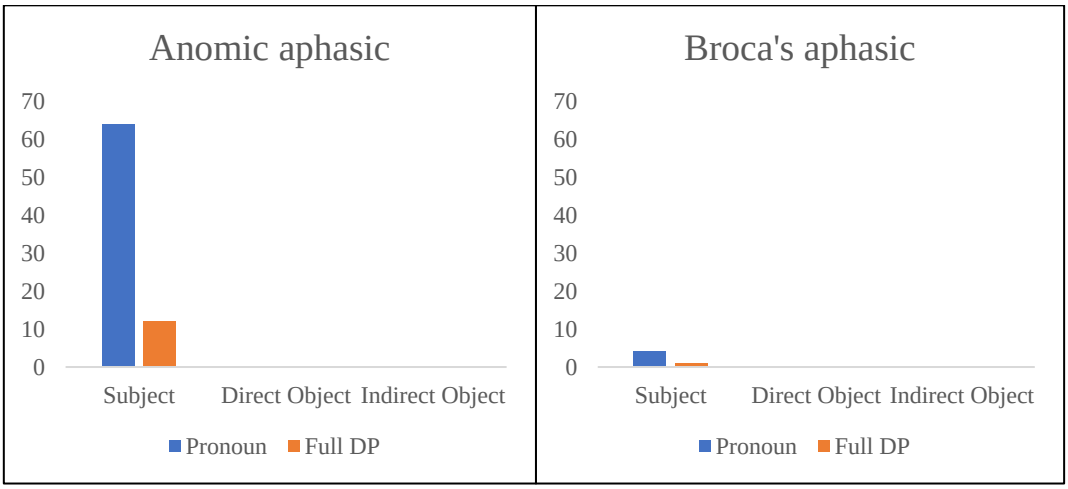
6.2.2. Are theta roles associated to a specific DP function?

The data in this section will be discussed bearing in mind the type of theta role and its form-function relationship.

- **Agent theta role**

In figure 8 it can be seen how agents (role) function as subjects (function) and are mostly realised as pronouns (form). The data obtained are similar for both speakers, as expected.

Figure 8. **Participants' agent production: form-function**

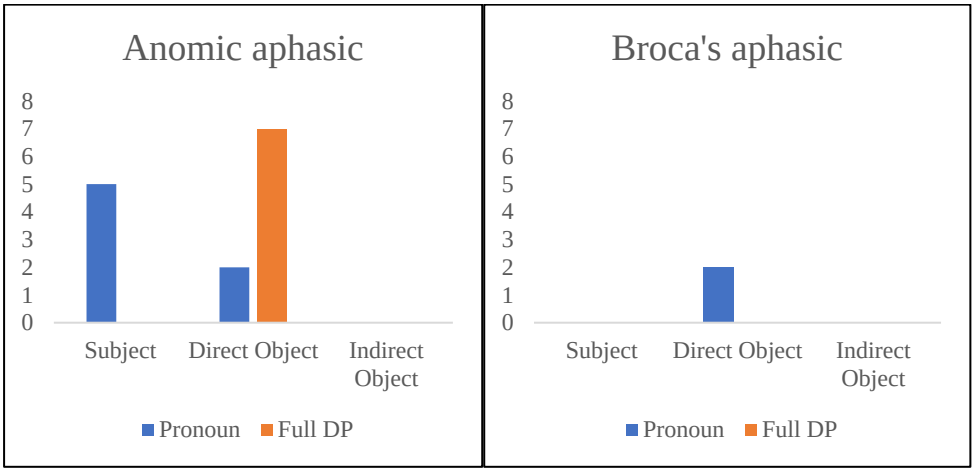


- **Patient theta role**

Figure 9 shows the results obtained considering the patient theta role and several differences are found between both participants. On the one hand, the anomic participant assigns the patient theta role to subjects and to direct objects; however, in the case of subjects, they are mostly pronouns, contrary to direct objects, which are mostly used as full DPs. Thus, the anomic participant's production complies with the idea that patients would be mostly produced as direct objects; and, that all the patients, which are direct objects, are realised mostly

by full DPs. On the other hand, Broca's participant only produces the patient theta role assigned to direct objects, which are realised by pronouns. Nevertheless, it was expected that the patient role will be assigned to an argument that functions as direct object, but with full DP form. Hence, this expectation is not confirmed in the case of the Broca's participant. Besides, the fact that the patient role is assigned to subjects points to the fact that the anomic speaker produces some passive voice sentences.

Figure 9. **Participants' patient production: form-function**

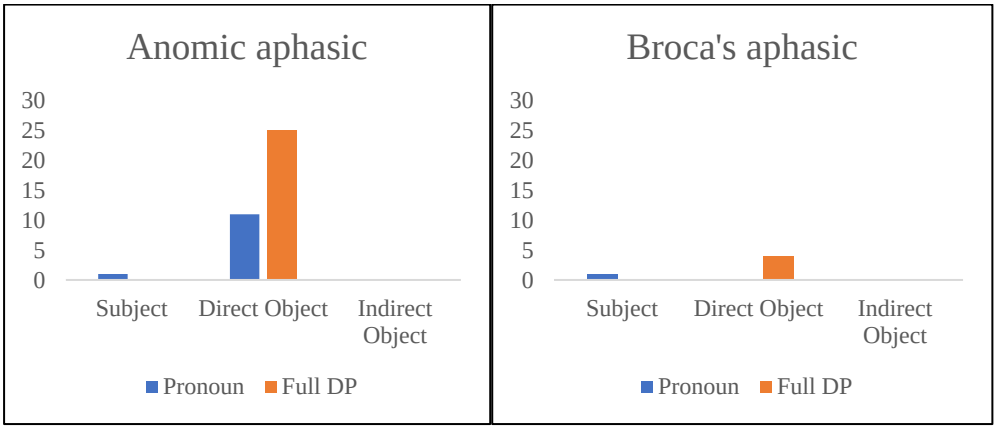


- **Theme theta role**

Regarding the theme role (figure 10), the participants behave as expected in that themes are mostly realised as direct objects and full DPs. Still, it is not the only pattern followed, as some themes are subjects and pronouns; and others are direct objects and pronouns. Broca's participant produce themes that are, in decreasing order, direct objects and full DPs and subjects and pronouns. Whereas the anomic participant produces themes that are, in decreasing order, direct objects and full DPs, afterwards, direct objects and pronouns, and lastly, subjects and pronouns.

Moreover, although it is not reflected in figure 10, three cases of WH-pronouns have been encountered when analysing the anomic aphasic's data.

Figure 10. **Participants' theme production: form-function**

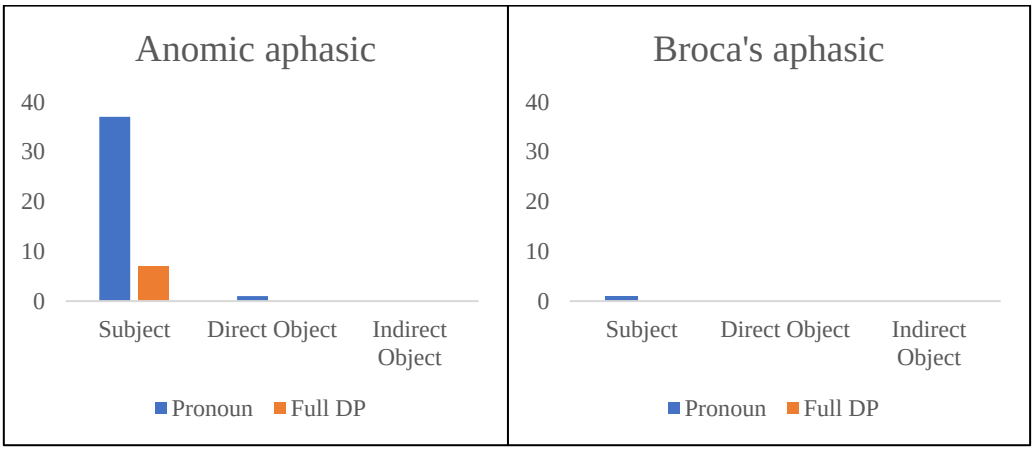


- **Experiencer theta role**

Figure 11 shows the production of experiencer roles. The results obtained in this case are different from what expected in two ways. First, it was stated that experiencers will be assigned to direct objects and, second, that they will carry full DP form. However, most experiencers are subjects and mostly pronouns.

Such number of experiencers functioning as subjects is due to the fact that sense verbs typically have experiencer subjects, as the subjects are not voluntarily controlling the action and, therefore, these subjects cannot be agents. As the participants are telling their own experiences, themes are not always full DPs, but rather the subject pronoun "*I*" most of the times.

Figure 11. **Participants' experiencer production: form-function**

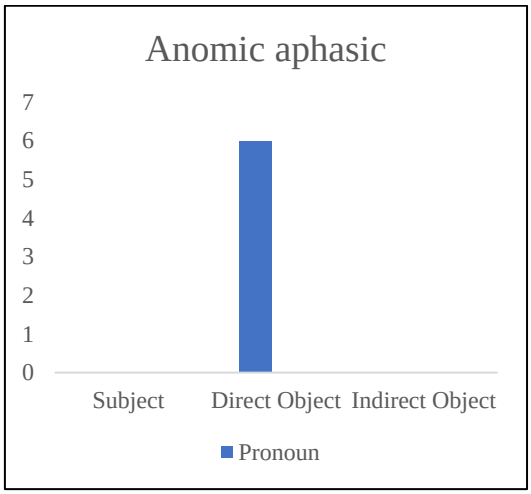


- **Beneficiary theta role**

In figure 12, the beneficiary role production by the anomic participant is represented only as Broca's participant does not produce any beneficiary role within his speech.

In this case, it was presumed that this role would be assigned to an indirect object, which would be a pronoun. However, indirect objects are not produced neither by Broca's nor by the anomic participants. Rather, this role is assigned to direct objects with pronoun form.

Figure 12. Anomic participant's beneficiary production: form-function



To sum up, it is true that some theta roles are associated to a certain form or function. Subjects mostly received the form of pronouns and most of them carry out the agent theta role; themes are usually direct objects with a full DP form; patients are mostly direct objects. However, some other associations are not seen in the data. The patient role is not mostly realised as a full DP, but rather as a pronoun. Experiencers are not mostly direct objects and full DPs but rather subjects in most of the cases as they are selected by sense verbs. Considering the theta roles under analysis in this study, it can be concluded that some associations between theta roles and forms and between theta roles and functions hold (e.g. the subject-agent relation) while some others do not (e.g. indirect object-beneficiary relation).

6.3. Question set 3: theta role assignment

6.3.1. Do Broca's aphasics produce structures in which with theta role assignment is complete?

The prediction here is that given that Broca's speech is incomplete, theta role assignment is not expected to proceed fully.

Broca's participant's speech lacks 48% of the arguments in the structures analysed, and, consequently, theta roles are not assigned because of their one-to-one relation. Although it may be common to think that this is because Broca's aphasic has an impairment that prevents him from assigning theta roles properly, this is not actually correct. Though Broca's aphasics try to make full sentences, their struggling to find a proper realization for arguments leads to the absence of arguments. The participant's difficulties to find a proper realization of words is evident in the data analysed, as he struggles to find a phonological representation for each word within his mental lexicon and thus, his phonetic representation is wrong or altered. However, by analysing the transcription of Broca's participant no impairment in theta role assignment has been detected, because, although he does not have an argument produced to which the role can be assigned, he uses non-verbal language to help his speech and complete the sentences in that way. This confirms that his non-verbal production is not impaired.

He has access to the semantic information of words within his mental lexicon, including verbs. Hence, the sentence order is not altered. Regarding the arguments selected by the verb, although they are not verbally produced, there is evidence of their existence within Broca's participant's production. In many cases, when the participant does not retrieve the right phonemic representation of a lemma and he is aware of it, he completes his speech pointing the missing argument and, therefore, assigning the proper theta role to it. Yet, this kind of non-verbal arguments have not been analysed in this work as the focus is placed on the participant's verbal production.

6.3.2. Do anomic aphasics produce structures in which with theta role assignment is complete?

As opposed to that for Broca's participant, the prediction for the anomic participant involved a lack of unassigned theta roles.

When providing an answer to this research question several conclusions have been reached. Firstly, there is a rate of 2.7% (5 cases) out of the total number of arguments analysed where missing theta roles appear in the anomic participant's speech. Most of the incomplete clauses produced by her are grammatical, because she consciously starts the DP production but leaves it incomplete. She does not have any impairment in retrieving syntactic or semantic information from the lexicon; rather this mistake is due to his word finding difficulties, as in (20).

(20) PAR: &-um <I went to the> [//] &ha &-uh &n Terry took me to the &hos +//

(Fridriksson Corpus, 02)

She leaves the sentences incomplete, as in (20), and he moves on into the next one, because syntax is not an issue. Thus, the anomic participant does not make mistakes when assigning theta roles.

Moreover, both participants know the idea they are trying to express. An evidence of this is that they try to describe it, so this supports the idea that their semantic information is intact and that the problem comes when assigning phonemic representations to lemmas. When this happens, three possibilities are found: the first option is that the speaker does not find any phonemic representation. In the second option, he finds a word which is similar phonemically but does not have any meaning. And finally, in the last option, he finds a word with a similar phonemic representation but with a different meaning, and consequently with a different theta role from the word that he actually articulates. Regarding the last option, the assignment of

different theta roles happens because the speaker has access to the semantic features of the lemma and does not have problems retrieving them. However, he fails when selecting the phonemic representation, so he articulates the word, but the theta roles and the diacritic features will be assigned by the lemma.

To conclude, theta role assignment is not altered in the anomic and Broca's aphasics' production. Furthermore, their impairment in the speech production process happens in the last stage of the process (see figure 1), as the participants retrieve the proper syntactic and semantic information from their lexicon. Their problem comes when retrieving phonological information of words from the lexicon.

7. Conclusions

This dissertation presents a study on the production of theta roles by two aphasic speakers, one anomic and one Broca's. To carry out this study, data have been taken from the Fridriksson Corpus, which is available in the Aphasia Bank in Talk Bank (MacWhinney et al.). After selecting the data, the results obtained have been classified according to their theta role type, DP form and DP function. From this, several conclusions have been reached to give answer to the previously established research questions.

Regarding question set 1, the results point that Broca's and anomic participants produce pronouns at a higher rate than full DPs even if, regarding previous studies, Broca's participant was expected to produce more full DPs. In terms of form, theta roles are associated to a specific form in some cases. For both aphasics, as it was expected, agents are mostly produced as pronouns and themes as full DPs. Beneficiaries have been produced only by the anomic participant and, as anticipated, in the form of pronouns. Besides, experiencers' preconception is followed by Broca's participant with a production of full DPs mostly. However, there were expectations which have not been confirmed by any participant. Contrary to what was

expected, the anomic speaker's production of experiencers is mostly realised in pronoun form; and the anomic and Broca's speakers realise patients as pronouns.

Considering question set 2, Broca's and anomic participants are expected to produce functions to a similar extent. However, only Broca's aphasic follows this pattern when producing a similar number of direct objects and subjects. Whereas the anomic participant produces more subjects. Neither of them produces DP indirect objects. Moreover, some theta roles are associated to a specific function. Agents and experiencers are associated to subjects while patients, themes and beneficiaries to direct objects. Unexpected results have been found, however. There were beneficiaries acting as direct objects although they were expected to act as indirect objects. Also, experiencers act as subjects, but they were expected to act as direct objects.

The last question set refers to the proper assignment of theta roles considering the participants separately. On the one hand, theta role assignment is not fully accomplished by the Broca's aphasic. However, Broca's participant's theta role assignment process is not impaired as he completes sentences non-verbally by pointing referents. On the other hand, contrary to what was expected, the anomic participant's theta role assignment is not fully accomplished either, due to some missing arguments. However, this is not due to the theta role assignment process itself, because the assignment as such is produced, even if there are some uncompleted arguments. Thus, the theta role assignment process as such does not seem to be impaired.

These conclusions show a linguistic analysis of aphasics' speech dealing with theta roles. From this point, the main conclusion of the study is that Broca's and anomic aphasics are not impaired in theta role assignment but in accessing a phonological representation of the lemma and its articulation. Taking this into consideration, further analyses on other apparently impaired features of their language could be studied.

It would be interesting to consider more participants to get wider results. Also, comparing these with a group of typically developed speakers could lead to interesting conclusions. Moreover, for further research, different data collection the methodologies could be used by interviewing participants personally and obtaining semi-spontaneous data or other type of experimental data. From this point, tasks could be oriented in a specific way or discipline and the coverage of result would be higher.

The development of this study has been interesting because most studies on aphasics deals with clinical treatments and not with more linguistics analyses. It is also important to consider linguistics to develop treatments on language, in a way that aphasics' deficits would be covered more especifically. Furthermore, the conclusions and discoveries on aphasics' language deficits could support teaching methodologies in non-typically developed speakers' context.

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