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RESEARCH REPORT

THE LINGUISTIC IMPAIRMENT OF THE **PERFECT** ASPECT IN **ALZHEIMER**'S DISEASE AND LOGOPENIC PRIMARY PROGRESSIVE **APHASIA**

Jean Carlos da Silva GOMES
Universidade do Estado do Rio Grande do Norte (UERN)
Universidade Federal do Rio de Janeiro (UFRJ)

Adriana Leitão Martins
Universidade Federal do Rio de Janeiro (UFRJ)

Fernanda de Carvalho RODRIGUES
Universidade Federal do Rio de Janeiro (UFRJ)

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EDITORS
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ABOUT THE AUTHORS
– Jean Carlos da Silva Gomes
Conceptualization, Data Curation, Metodoloy, Formal Analysis, Investigation, Writting – Original Draft.
– Adriana Leitão Martins
Conceptualization, Metodology, Writting – Review and Editing, Supervision, Project Administration.
– Fernanda de Carvalho Rodrigues
Metodology, Visualization, Supervision, Writting – Review and Editing.

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ABSTRACT

Taking into account that neuropsychological studies with subjects with language pathologies can contribute to the investigation of the organization of syntactic knowledge, the objective of this work is to investigate the syntactic representation of the perfect aspect based on data from subjects with pathologies that affect their language. More specifically, we aimed to investigate the possible phrases associated with the types of the perfect aspect and the hierarchy among them. Therefore, we sought to verify a possible linguistic impairment of this aspect in individuals diagnosed with Alzheimer's Disease (AD) and Logopenic Primary Progressive Aphasia (LPPA). A double case study was carried out with one patient with AD and another with LPPA. The methodology consisted of applying functionality tests, neuropsychological tests, and linguistic tests. The results indicated that both the AD patient and the LPPA patient present functional decline and cognitive impairment, with the degree of impairment of the first patient being more extensive than that of the second one in both cases. Regarding language, the patient with AD showed impairment with all four types of perfect, present tense, and imperfective aspect, whereas

the LPPA patient has shown impairment only in perfect of recent past and present tense. Based on the results we propose the existence of a phrase to perfect of recent past and the dominance of the temporal phrase over the perfect phrases in the syntactic hierarchy.

RESUMO

Levando-se em conta que estudos neuropsicológicos com sujeitos com patologias da linguagem podem contribuir para a investigação acerca da organização do conhecimento sintático, o objetivo deste trabalho é investigar a representação sintática do aspecto *perfect* a partir de dados de sujeitos portadores de patologias que afetam a linguagem. Mais especificamente, visou-se investigar os possíveis sintagmas associados aos tipos de aspecto *perfect* e a hierarquia entre eles. Para tanto, buscou-se verificar um possível comprometimento linguístico desse aspecto em indivíduos diagnosticados como portadores da Doença de Alzheimer (DA) e da Afasia Logopênica Progressiva Primária (APPL). Realizou-se um estudo de caso duplo com uma paciente com DA e outra com APPL. A metodologia consistiu na aplicação de testes de funcionalidade, testes neuropsicológicos e testes linguísticos. Os resultados indicaram que tanto a paciente com DA quanto a paciente com APPL apresentam declínio funcional e prejuízo cognitivo, sendo o grau de comprometimento da primeira paciente maior do que o da segunda em ambos os casos. Quanto à linguagem, a paciente com DA apresentou um comprometimento com os quatro tipos de *perfect*, tempo presente e aspecto imperfectivo, enquanto a paciente com APPL apenas com *perfect* de passado recente e tempo presente. Baseado nos resultados, propuseram-se a existência de um sintagma para o *perfect* de passado recente e a dominância do sintagma temporal em relação aos sintagmas de *perfect* na hierarquia sintática.

KEYWORDS

Perfect aspect; syntactic representation; Alzheimer's disease; logopenic primary progressive aphasia; linguistic impairment.

PALAVRAS-CHAVE

Aspecto perfect; representação sintática; doença de Alzheimer; afasia progressiva primária logopênica; comprometimento linguístico.

INTRODUCTION

According to Generativism, the theoretical framework adopted in this work, language is a genetically determined capacity, being innate to human beings (CHOMSKY, 1957; LENNEBERG, 1964). According to this theory, the human mind is understood as modular, what means that it is formed by different cognitive modules governed by specific principles which establish interactions among themselves (FODOR, 1983), such as memory, thought, language, etc. The linguistic module can also be divided into others, such as phonetics, syntax, and semantics, in a way that it is possible to study them separately (HAUSER; CHOMSKY; FITCH, 2002). In this study, we investigate knowledge regarding the syntactic categories of tense and aspect.

Tense, according to Comrie (1985), is defined as the category that allows us to situate the events of the world in physical time. In languages that perform a three-way temporal analysis, such as English and Portuguese, the three absolute tenses are past, present, and future (REICHENBACH, 1947; COMRIE, 1985). Aspect, in turn, according to Comrie (1976), refers to the different ways of visualizing the internal temporal composition of a situation and can be divided into grammatical and semantic.

The grammatical aspect, which is the focus of this work, is the one expressed by the grammatical elements contained in the sentence, such as, for example, the verbal morphology (COMRIE, 1976; CINQUE, 1999), and it is commonly divided into two types: perfective and imperfective. The perfective allows the visualization of a situation as a whole, without distinguishing between the phases that compose it, as in "John cleaned the house", while the imperfective emphasizes the internal composition of the situation, allowing the visualization of at least one of its phases, as in "John was cleaning the house".

Although tense and aspect present an extensive relationship, they are not a single system (HORNSTEIN, 1990). These categories differ both conceptually and linguistically, with several shreds of evidence of a dissociation between them in syntactic representation (BOK-BENNEMA, 2001; BRAGA, 2004; LESSA, 2015; RODRIGUES, 2011). In several syntactic linguistic researches, it has been proposed, then, that there are a phrase that encompasses tense-related knowledge (TP) and another one for perfective/imperfective grammatical aspect (AspP).

In addition to the basic grammatical aspects mentioned above, there is also the perfect aspect, which is not in opposition to the perfective and imperfective, but in addition to them in a sentence. The perfect, according to Pancheva (2003), refers to a time interval known as the perfect time span, which includes the moment of the event and extends to the moment of reference, which may coincide with the present, the past, or the future. When associated with the present, the perfect refers to a situation that began or

ended in the past and persists or has its effects expressed in the present (MCCAWLEY, 1981; IATRIDOU; ANAGNOSTOPOULOU; IZVORSKI, 2003; NESPOLI, 2018).

Several classifications for the perfect have been proposed in the literature. Among them, we present here two, one in which it is divided into four types and another into two. In a four-type classification (COMRIE, 1976; ESPINO, 2007), the perfect is divided into (i) perfect of persistent situation, which refers to a situation that started in the past and persists until the present ("Mary has danced ballet since 2005"); (ii) perfect of result, which refers to a present state as a result of a past situation ("I have had a bath"); (iii) experiential perfect, which refers to a situation that occurred at least once in the past and configures an experience in the present ("John has been to Mexico"); and (iv) perfect of recent past, which refers to a past situation conceived as very close to the present time ("Mary has just arrived"). In a classification in which the perfect is divided into two types (MCCAWLEY, 1981; MITTWOCH, 1988; IATRIDOU; ANAGNOSTOPOULOU; IZVORSKI, 2003; NESPOLI, 2018), there are (i) the universal perfect, which refers to a situation that started in the past and persists until the present ("I have been sick since 1990"), and (ii) the existential perfect, which refers to a situation that started and ended in the past and has relevance in the present ("I have lost my glasses").

Thus, we understand that the universal perfect resembles the perfect of persistent situation, since both are related to the persistence of a past situation in the present, while the existential perfect resembles the perfect of result, experiential perfect, and perfect of recent past, since, in these, the situation ended in the past is conceived as relevant in the present. Still, it is noteworthy that such an association is not consensual for all authors in the literature on the subject (MITTWOCH, 1988; NESPOLI, 2018).

Regarding the syntactic representation of the perfect, authors like Alexiadou, Rathert, and Von Stechow (2003) and Iatridou, Anagnostopoulou, and Izvorski (2003) proposed that there should be only one phrase for the perfect in the syntactic tree, the PerfP. This would be dominated by the tense phrase (TP) and would dominate that of the perfective/imperfective aspect (AspP). On the other hand, Nespoli (2018), based on assumptions of syntactic cartography, advocated for a split of PerfP in the structural representation, postulating the existence of a phrase for the universal type, the UPerfP, and another for the existential type, the EperfP. For this author, the hierarchy observed among these phrases is as follows: TP > UPerfP > EPerfP > AspP. Furthermore, Rodrigues (2019), when analyzing data from a child acquiring Brazilian Portuguese (BP), besides reiterating the need for a split between UPerfP and EPerfP, argued that there would be a phrase for the experiential type, ExPerfP, which would dominate UPerfP. For this author, the observed hierarchy between these phrases is as follows: ExPerfP > UPerfP > EPerfP > TP > AspP. Given the divergence observed among the postulations about the perfect

phrase and the hierarchy among them, the general objective of this paper is to investigate the syntactic representation of the perfect aspect.

One possible way to verify how linguistic knowledge is organized in the human mind is by analyzing the linguistic production of individuals with deviant languages, such as Alzheimer's disease patients. Thus, we believe that the analysis of the linguistic expression of these subjects may contribute to the research of the linguistic phenomenon investigated in this paper.

Alzheimer's disease causes a progressive and irreversible deficit in cognitive functions, also causing behavioral changes in the patient. According to Jorm (1985), it is considered that there are three variants of this pathology: the classic, the frontal, and the posterior being commonly respectively referred to as Alzheimer's disease, Logopenic Primary Progressive Aphasia, and Posterior Cortical Atrophy. In this paper, we focus on the data from the first two variants presented, since in their patients the impairment in linguistic expression is earlier. It should be taken into account that, throughout this article, the acronym AD refers to the classic variant, the acronym LPPA refers to Logopenic Primary Progressive Aphasia, and the term Alzheimer's Disease is used to refer to both variants at the same time. There is no consensus that LPPA is a variant of Alzheimer's Disease, but authors such as Jorm (1985), Baeza, Bustos, and Ovando (2012), Madhavan *et al.* (2012), and Serra-Mestres (2017) establish such a relationship by taking into consideration neuropathological factors involving LPPA and Alzheimer's Disease clinical pictures.

In AD, it is considered that the most evident deficit is the one that affects declarative memory, although other cognitive abilities are also altered, such as language. Martins (2010), Lessa (2010), Fyndanis *et al.* (2012) and Nespoli (2013) also pointed out that in this pathology linguistic alterations can be found in the expression of tense and aspect categories. However, none of these studies have addressed the examination of the perfect aspect. Gomes (2018), in a pilot study that contained analyses of the spontaneous speech of an individual with AD, argued that the perfect, both of the universal and existential types, can be impaired in this pathology, and an investigation from experimental data is needed to confirm the author's argument, a gap that is intended to be filled with this study.

In LPPA, the initial deficit is mainly on language so that other cognitive losses occur only in the later stages of the disease (ETCHEVERRY *et al.*, 2012). LPPA is a rare pathology and, according to Croot *et al.* (2009), there is still much to be studied about such a pathology. The deficit commonly described as characterizing this disease is related to fluency, resulting from a phonological and lexical impairment (WILSON *et al.*, 2010; BAEZA; BUSTOS; OVANDO, 2012). Even so, authors such as DeLeon *et al.* (2012) and Caixeta *et al.* (2014) show evidence that the individuals affected by this pathology may also present

linguistic alterations of syntactic nature. It is worth noting, however, that there are no investigations on a possible impairment of tense and aspect in these patients.

Considering that patients with AD and LPPA present deviant language, we believe that an investigation about a possible linguistic impairment of the perfect aspect may provide evidence for the investigation of its syntactic representation in the faculty of language. Given that, the specific objectives of this work are: (i) to investigate, in subjects diagnosed with Alzheimer's disease, both AD and LPPA, native speakers of BP, whether there is an impairment in the linguistic expression of the perfect aspect associated with the present tense; (ii) to compare the performance of patients of the two variants investigated; (iii) if the patient(s) have a linguistic impairment, to investigate which type(s) of perfect the deficit affect(s).

Three hypotheses were formulated for this study. Given the impairments of tense and aspect in Alzheimer's disease described in the literature (MARTINS, 2010; LESSA, 2010; FYNDANIS *et al.*, 2012; NESPOLI, 2013), the first hypothesis is that there is an impairment in the linguistic expression of the perfect, when associated with present tense, in individuals diagnosed with AD and LPPA native speakers of BP. Taking into consideration the earlier language impairment in patients with LPPA than in patients with AD described in the literature (ETCHEVERRY *et al.*, 2012; ARAÚJO *et al.*, 2015), the remaining hypotheses are that the impairment in the linguistic expression of the perfect, when associated with present tense, of native BP-speaking individuals diagnosed with AD is selective, not affecting all of its types, and that the impairment in the linguistic expression of perfect, when associated with present tense, of native BP-speaking individuals diagnosed with LPPA is not selective, affecting all of its types.

1. MATERIAL AND METHODS

1.1. DECLARATION OF ETHICAL APPROVAL

This study was submitted to "*Plataforma Brasil*", having been analyzed and approved by the Research Ethics Committee of the Institute for Studies in Public Health (IESC) of the Federal University of Rio de Janeiro (UFRJ), under the number 15566119.0.0000.5286. Before participating in any stage of the research, the researcher and the participants or their legal guardians signed an Informed Consent Form.

1.2. PARTICIPANTS

Bearing in mind that case studies have proven to be efficient in investigations about language deficits in pathologies (BERNDT; CARAMAZZA, 1999; NOVAES, 2004), this

research developed a double case study. Therefore, two patients were selected, one diagnosed as having AD and the other as having LPPA. Both patients had received the diagnosis of the disease three years before their participation in this research. Besides, four healthy elderly subjects were selected to act as a control group, two of them having a similar profile in terms of education, gender, and age group to the patient with AD and two of them to the patient with LPPA. Finally, 30 healthy adult individuals between 40 and 59 years old also performed the tasks designed specifically for this study in order to validate them.

1.3. MATERIALS

The methodology adopted in this work consisted of the application of two functionality tests, two neuropsychological tests, and two linguistic tests. The application of non-linguistic tests aimed to characterize the general cognitive status of the patients and to assess the relationship between language and other cognitive domains.

The two functionality tests used were the Functional Activities Questionnaire, originally developed by Pfeffer *et al.* (1982), which is an evaluation of the instrumental activities of daily living that the subject is still able to do, and the ASHA-FACS, whose translation and validation to Brazilian Portuguese was performed by Carvalho and Mansur (2008), which is a functional evaluation of communication skills. These tests were completed by the collateral informants - subjects who ideally have lived with the patients for at least ten years - of the participants diagnosed with Alzheimer's disease.

Regarding neuropsychological tests, the Brazilian version of the Mini-Mental State Examination (MMSE), developed by Caramelli and Nitrini (2000), was used to assess the cognitive status of the subjects, and the Sequential Ordering of Events Test,[1] developed by Nespoli (2013), was used to assess the knowledge regarding conceptual notions of time. These tests were applied to participants diagnosed with Alzheimer's disease and their controls since the objective was that these subjects did not present cognitive deficits.

In addition, two off-line linguistic tests, a gap-filling test and a grammaticality judgment test, were designed specifically for this study to assess the knowledge regarding the perfect and other tense and aspect notions present in sentences that convey this aspect.

In the first test, the gap-filling test, participants read and listened to a sentence containing a gap that should be filled by one of the three answer options provided by

1 In this test, the researcher presented ten sets of images composed of four pictures each to the participants. The pictures portrayed the development of different events (for example: washing the dishes, drinking juice, making the bed etc.). The researcher indicated which was the first picture in each set and the participants should order the others following the logical order of the development of the situation.

the researcher, with only one correct answer. The test was composed of 63 sentences, 21 of which were targets and 42 were fillers. Taking into account that patients with Alzheimer's disease have linguistic problems, it was decided to avoid syntactically complex structures, so the subject-verb-object order and the canonical order of thematic role attribution were maintained.

All the target sentences contained gaps in the verb position. In each of them, there was an adverb / adverbial expression and/or a clause preceding the gap to induce the investigated tense and aspect reading. Seven conditions were formulated, namely: (i) universal perfect / perfect of persistent situation, as in the example in (1); (ii) existential perfect / perfect of result, as can be seen in the example in (2); (iii) existential perfect / experiential, as in the example in (3); (iv) existential perfect / perfect of recent past, as in the example in (4); (v) past perfective, as shown in the example in (5); (vi) past imperfective, as in the example in (6); and (vii) present imperfective, as in the example in (7). In each of these conditions, there were three sentences.

(1) Desde 2000 até hoje em dia, Maria (tem pintado / pintou / pintava) quadros.[2]
ADV 2000 until today in day, Mary (have.PRES paint.PART / paint.PFV / paint.IPFV.PST) pictures
'Since 2000 until now, Mary (has painted / painted / painted) pictures'

(2) João está cheiroso porque ele já (tem passado / passou / passava) o perfume.
John be.PRES smelling-good because 3SG.M ADV (have.PRES put-on.PART / put-on.PFV / put-on.IPFV.PST) the perfume
'John is smelling good because he (has already put on/ already put on/ already put on) the perfume'

(3) Maria já (tem comido/ comeu / comia) uma comida estragada.
Mary ADV (have.PRES eat.PART / eat.PERF / eat.IPFV.PST) a food spoiled
'Mary (has already eaten / already ate / already ate) a spoiled food'

(4) Recentemente, João (ganhou / tem ganhado / ganhava) uma medalha.
ADV, John (win.PERF / have.PRES win.PART / win.IPFV.PST) a medal
'Recently, John (won / has won / won) a medal'

(5) Ontem, Maria (perde / perdeu / perdia) a chave.
ADV, Mary (lose.PRES / lose.PFV / lose.IPFV.PST) the key
'Yesterday, Mary (loses / lost / lost) the key'

2 In the article, we underlined the correct answers. However, it is worth noting that there was no highlighting in the presentation of the sentences to the participants.

(6) Antigamente, Maria (conta / contou / contava) piadas.
ADV, Mary (tell.PRES / tell.PFV / tell.IPFV.PST) jokes
'In the past, Mary (tells / told / told) jokes'

(7) Atualmente, Maria (lava / lavou / lavava) pratos.
ADV, Mary (wash.PRES / wash.PFV / wash.IPFV.PST) dishes
'Currently, Mary (washes / washed / washed) dishes'

The 42 fillers, in turn, did not have gaps in the verb position, nor did they contain time adverbs or adverbial expressions in their formulation. These were divided into 4 groups, namely: (i) 10 sentences with gaps in the intensifier position, as in (8); (ii) 10 sentences with gaps in the prepositional phrase, as in (9); (iii) 11 sentences with gaps in the position of verbal complement, as in (10); and (iv) 11 sentences with gaps in the position of NP complement of a determiner taking into account gender agreement between determiner and noun, as in (11).

(8) João esquentou (muito / quão / tão) o leite.
John heat.PFV (a lot / how / so) the milk
'John heated (a lot / how / so) the milk'

(9) João pulou a corda (para medo / até medo / sem medo).
John jump.PFV the rope (for fear / until fear / without fear)
'John jumped the rope (for fear / until fear / without fear)'

(10) Maria beijou (o rapaz / a dengue / o grito).
Mary kiss.PFV (the boy / the dengue / the scream)
'Mary kissed (the boy / the dengue / the scream)'

(11) Maria digitou um (linha / palavra / texto).
Mary type.PFV ART.M (line.F / word.F / text.M)
'Mary typed a (line / word / text)'

In the second linguistic test, the grammaticality judgment test, participants read and listened to a sentence and should judge it as natural or extraneous. The test consisted of 84 sentences, 28 targets, and 56 fillers, in which half were grammatical and half were ungrammatical.

Seven conditions were also formulated for the target sentences, each with two grammatical and two ungrammatical sentences, namely: (i) universal perfect / perfect of persistent situation, as in (12a) and (12b); (ii) existential perfect / perfect of result, as in (13a) and (13b); (iii) existential perfect / experiential perfect, as in (14a) and (14b); (iv) existential perfect / perfect of recent past, as in (15a) and (15b); (v) past perfective, as in

(16a) and (16b); (vi) past imperfective, as in (17a) and (17b) and (vii) present imperfective, as in (18a) and (18b). The ungrammaticality in the target sentences was always due to a mismatch between the adverb/ adverbial expression and the verb form.

(12) (a) Desde a infância até hoje em dia, Maria tem pintado quadros.
ADV. the childhood until today in day, Mary have.PRES paint.PART pictures
'Since childhood until now, Mary has painted pictures'
(b) *Desde criança até hoje em dia, João pintou paisagens.
ADV. childhood until today in day, John paint.PFV landscapes
'Since childhood until now, John painted landscapes'

(13) (a) João está cheiroso porque ele já passou o perfume.
John be.PRES smelling-good because 3SG.M ADV put-on.PFV the perfume
'John is smelling good because he put on the perfume'
(b) *Maria está arrumada porque ela já tem passado a maquiagem.
Mary be.PRES dress.PART because 3SG.F ADV have.PRES put-on.PART the makeup
'Mary is dressed because she has already put on makeup'

(14) (a) Maria já comeu uma comida estragada.
Mary ADV eat.PFV a food spoiled
'Mary has already eaten a spoiled food'
(b) *Maria já tem comido um pote de ração.
Mary ADV have.PRES eat.PART a bowl of feed
'Mary has already eaten a bowl of feed'

(15) (a) Recentemente, João ganhou uma medalha.
ADV John win.PFV a medal
'Recently, John has won a medal'
(b) *Recentemente, João tem ganhado um prêmio.
ADV John have.PRES win.PART an award
'Recently, John has been winning an award'

(16) (a) Ontem, João pegou o guarda-chuva.
ADV John take.PFV the umbrella
'Yesterday, John took the umbrella'
(b) *Ontem, Maria pegava o casaco preto.
ADV Mary take.IPFV the coat black
'*Yesterday, Mary took the black coat'

(17) (a) Antigamente, Maria comprava álbuns de figurinha.
ADV Mary buy.IPFV.PST albums of sticker
'In the past, Mary bought sticker albums'
(b) *Antigamente, João comprou balões de ar.
ADV John buy.PFV balloons of air
'In the past, John bought air balloons'

(18) (a) Atualmente, Maria lava pratos.
ADV Mary wash.PRES dishes
'Currently, Mary washes dishes'
(b) *Atualmente, João lavava carros.
ADV John wash.IPFV.PST cars.
'Currently, John washed cars'

The filler sentences were divided, as in the previous test, into four groups consisting of six grammatical and six ungrammatical sentences each. Thus, the conditions concerned: (i) proper use of intensifiers, as in (19a) and (19b); (ii) proper use of preposition, as in (20a) and (20b); (iii) use of lexical items appropriate to the semantic selection of the verb, as in (21a) and (21b); and (iv) compatibility between the gender of the article and the complement noun of that determiner, as in (22a) and (22b).

(19) (a) João abriu demais a torneira.
John open.PFV ADV the tap.
'John opened the tap too much'
(b) *Maria abriu quão a porta.
Mary open.PFV ADV the door
'Mary opened how the door'

(20) (a) João pulou corda sem medo.
John jump.PFV rope without fear
'John jumped rope without fear'
(b) *Maria pulou o muro até pressa.
Mary jump.PFV the wall until hurry
'Mary jumped the wall until hurry'

(21) (a) João quebrou o copo.
John break.PFV the glass
'John broke the glass'
(b) *Maria quebrou o vento.
Mary break.PFV the wind
'Mary broke the wind'

(22)(a) Maria limpou a janela.
Mary clean.PFV ART.F window.F
'Mary cleaned the window'
(b) *João limpou a chão.
John clean.PFV ART.F floor.M
'John cleaned the floor

The linguistic tests were applied to the patients, the elderly controls, and 30 healthy adult participants. The application to this group occurred as a proposed validation of the experiments. The results indicated that the tests proved productive for the examination of the investigated phenomenon, since the participants understood the task they were supposed to perform, and the results generally corresponded to expectations.

1.4. PROCEDURES

The application of the tests to the patients and elderly controls was carried out in an individualized environment, with only the researcher and the participant present, without any noise or external stimuli interfering in the performance of the tasks. The same procedure was adopted in the application of the tests to the group of healthy adult controls; however, in the case of this group, the tests were handed out on a printed sheet to be filled out without direct interaction with the researcher.

2. RESULTS

2.1. RESULTS OF THE PATIENT DIAGNOSED WITH AD AND HER CONTROL PARTICIPANTS

In the Functional Activities Questionnaire, in which a score higher than 5 points indicates functional impairment, the patient scored 19 points out of 30. In the ASHA-FACS, in which a score lower than 5.9 indicates a communicative functional impairment, the patient scored 4.35 points out of 7.0. Thus, it is possible to observe that the patient has a functional impairment that also affects her communication.

Regarding the neuropsychological tests, in the MMSE, the patient scored 17 points out of 30, which, according to the evaluation criteria described by Brucki *et al.* (2003) adopted in this study, indicates the presence of cognitive impairment. Control I scored 26 points while control II scored 27 points, both scores higher than the minimum average, with such scores indicating the absence of cognitive impairment.

In the Sequential Ordering of Events Test, composed of 10 sequences of images that should be ordered by the participants, the AD patient correctly ordered only six, while controls I and II correctly ordered all of them. We interpret that the AD patient seems to have an impairment affecting notions related to the concept of time, while the controls do not.

Regarding the linguistic tests, in the gap-filling test, it was observed that in condition (i), which tested universal perfect / perfect of persistent situation, both the controls and the patient used the expected verb form in two gaps and one not expected verb form in a gap; in condition (ii), which tested existential perfect / perfect of result, the patient used the expected verb form in two gaps and an unexpected one in a gap, while the controls used the expected verb form in all gaps; in condition (iii), which tested existential perfect / experiential perfect, the patient used the expected verb form in two gaps and an unexpected one in a gap, while the controls used the expected verb form in all gaps; in condition (iv), which tested existential perfect / perfect of recent past, the patient used the expected verb form in two gaps and an unexpected one in one gap, while the controls used the expected verb form in all gaps; in condition (v), which tested past perfective, both the patient and the controls completed all gaps with expected verb forms; in condition (vi), which tested past imperfective, patient and control I used the expected verb form in one gap and an unexpected one in two gaps, while control II used the expected verb form in all gaps; and, in condition (vii), which tested present imperfective, patient and control I used the expected verb form in two gaps and an unexpected one in two gaps, while control II used the expected verb form in all gaps. The summary of these results is depicted in figure 1, below.

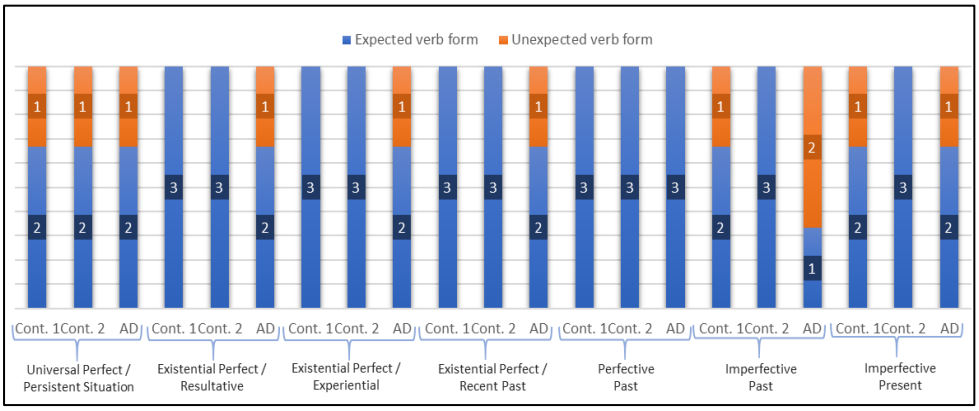

Figure 1. Results of the AD patient and controls on the gap-filling test.

In the second linguistic test, the grammaticality judgment test, in condition (i), which tested universal perfect / perfect of persistent situation, the patient judged all grammatical sentences as natural, one ungrammatical sentence as natural and one as

extraneous, while the controls judged all sentences in the expected way; in condition (ii), which tested existential perfect / perfect of result, the patient judged all the grammatical sentences as natural, one ungrammatical sentence as natural and one as extraneous, and control I performed as well as the patient while control II judged all the sentences in the expected way; in condition (iii), which tested existential perfect / experiential perfect, both the patient and the controls judged all the sentences as expected; in condition (iv), which tested existential perfect / perfect of recent past, the patient judged one of the grammatical sentences as natural and one as strange and one of the ungrammatical sentences as natural and one as strange, while the controls judged all the sentences as expected; in condition (v), which tested past perfective, both the patient and the controls judged all the sentences as expected; in condition (vi), which tested past imperfective, the patient judged all sentences, grammatical and ungrammatical, as extraneous, whereas control I judged the two grammatical sentences as natural, one ungrammatical sentence as strange and one as natural, and control II judged all sentences in the expected way; and, in condition (vii), which tested present imperfective, the patient judged one of the grammatical sentences as natural and one as extraneous and one of the ungrammatical sentences as natural and one as extraneous, while the controls judged all the sentences in the expected way. The summary of these results is depicted in figure 2 below.

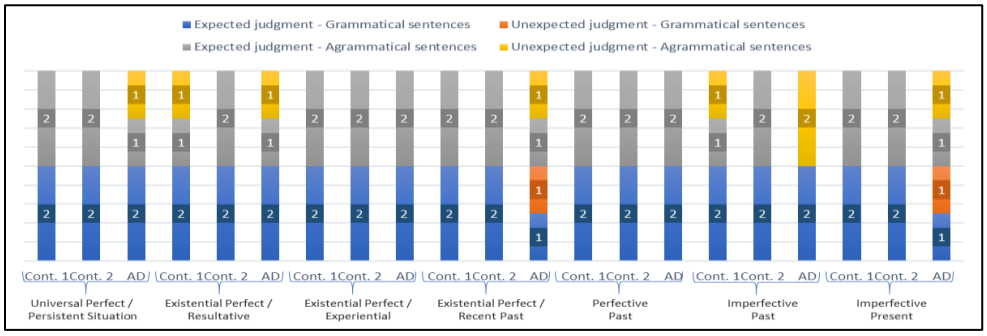

Figure 2. Results of the AD patient and controls on the grammaticality judgment test.

In general, it was observed through the results of the linguistic tests that the patient diagnosed with AD seems to have a major deficit with the category of existential perfect, covering the perfect of result, experiential and recent past types. In addition, the present tense and imperfective aspect also seem to be disrupted in her mental grammar. It is possible that the deficit also affects knowledge concerning universal perfect / perfect of persistent situation. However, it is not possible to state this clearly, since the errors found in the condition testing this aspect may be due to the deficit that affects present tense and imperfective aspect, categories of tense and aspect observed in sentences that convey universal perfect / perfect of persistent situation. On the other hand, the past tense and the perfective aspect seem to be preserved in the patient's mental grammar.

It was noted that the patient's linguistic performance seems to be related to her non-linguistic cognitive decline, since, in functionality and neuropsychological tests, problems of this nature were evidenced, including a deficit with conceptual notions regarding time and difficulties in temporal localization,[3] relevant knowledge in the linguistic realization of tense and aspect.

2.2. RESULTS OF THE PATIENT DIAGNOSED WITH LPPA AND HER CONTROL PARTICIPANTS

In the Functional Activities Questionnaire, in which a score higher than 5 points indicates functional impairment, the patient obtained a score of 10 points out of 30. In the ASHA-FACS, in which a score lower than 5.9 indicates a communicative functional impairment, the patient obtained 4.7 points out of 7.0. Thus, it is possible to observe that the patient has a functional impairment that also affects her communication, although less pervasive than in the patient with AD.

Regarding the neuropsychological tests, in the MMSE, the patient scored 20 points out of 30, which, according to the evaluation criteria described by Brucki *et al.* (2003) adopted in this study, indicates the presence of cognitive impairment. Control participant number I scored 30 points while control participant II scored 29 points, both with scores higher than the minimum average, which indicates the absence of cognitive impairment.

In the Sequential Ordering of Events Test, the patient with LPPA correctly ordered 9 out of 10 sequences, while control I, 10, and control II, also 9. We interpret that both the patient and the controls do not seem to present an impairment that affects notions related to the concept of time.

Concerning the linguistic tests, it was observed that in condition (i), which tested universal perfect / perfect of persistent situation, in condition (ii), which tested existential perfect / perfect of result, in condition (iii), which tested existential perfect / experiential perfect, in condition (v), which tested past perfective, and in condition (vi), which tested past imperfective, both the patient and the controls filled all gaps with the expected verb form. On the other hand, in condition (iv), which tested perfective existential / perfect of recent past, the patient used an unexpected verb form in one gap, and in condition (vii), which tested present imperfective, the patient used an unexpected verb form in two gaps,

3 It is worthy to mention that the Sequential Ordering of Events Test intended to access conceptual notions of time but this test also captures cause-effect relations. Besides, the session of the Mini Mental Sate Examination which investigates the subject's temporal orientation uses questions about the day, month and year in which s/he is and this kind of questions also depends on the subject's preserved memory. Thus, it is not possible to guarantee that the low performance is due to a disorder of conceptual notions of time or difficulties in temporal localization.

and in both cases, the controls filled all gaps with the expected verb form. The summary of these results is depicted in figure 3, below.

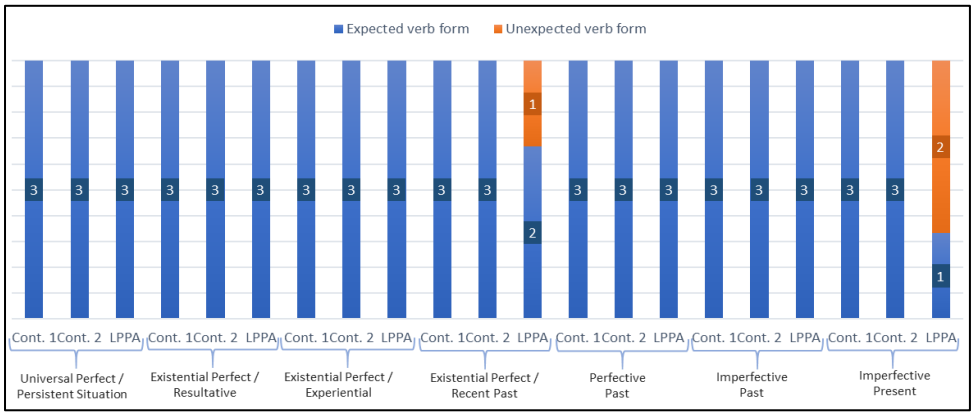

Figure 3. Results of the LPPA patient and controls on the gap-filling test.

In the grammaticality judgment test, in all target conditions, both the patient and the controls judged all grammatical sentences as natural. Concerning the ungrammatical sentences, in condition (i), which tested universal perfect / perfect of persistent situation, the patient judged both sentences as natural, control I judged one sentence as natural and one as odd, and control II judged both as odd; in conditions (ii), which tested existential perfect / perfect of result, (iii), which tested existential perfect / experiential perfect, (iv), which tested existential perfect / perfect of recent past, and (v), which tested past perfective, the patient judged both sentences as natural and the controls, both as odd; in conditions (vi), which tested past imperfective, and (vii), which tested present imperfective, the patient judged one sentence as natural and the other as odd while the two controls judged both sentences as odd. The summary of these results is depicted in figure 4, below.

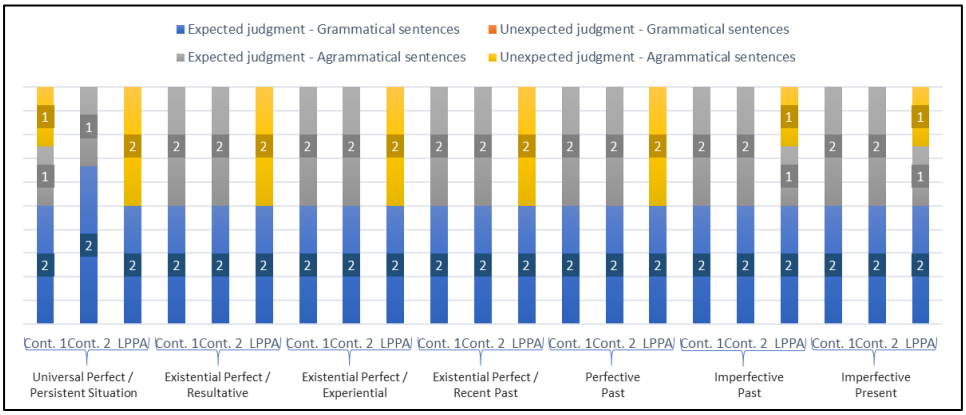

Figure 4. Results of the patient with LPPA and controls on the grammaticality judgment test.

Taking into consideration the results obtained in the tests, it seems plausible to assume that the patient has an impairment specifically on existential perfect / perfect of recent past and present time, revealed mainly in the first test. We believe that her linguistic performance is also related to her cognitive status taking into account her performance in the functionality tests and the MMSE. It is worth noting, however, that this patient showed a good result in the Sequential Ordering of Events Test, which seems to show that her deficit with the category of time affects only the linguistic module, not having affected the conceptual module yet, in line with statements by authors such as Martins (2010).

3. DISCUSSION

In general, it is possible to notice that in all tests the performance of the AD patient was worse than that of the LPPA patient. We understand that this is due to the relationship between general cognitive status and language, since the greater the cognitive deficit, the greater seems to be the impairment of linguistic categories in the mental grammar, as observed in the data of the patients in this study.

Regarding the deteriorated categories, both the AD and the LPPA patients have a deficit that lies in the existential perfect / perfect of recent past. In the case of the patient with LPPA, this deficit occurs on this type of the perfect without affecting the others. This is interpreted as evidence in favor of dissociating the perfect of recent past from the other types of perfect in the mental grammar, which justifies the proposition of a specific phrase for this aspect, which we name RecPerfP.

Taking into account the Tree Pruning Hypothesis (FRIEDMANN; GRODZINSKY, 1997), a theory on language impairment that conceives that impaired knowledge related to functional phrases indicates that such phrases are allocated higher up in the inflectional layer representation, we propose that the RecPerfP phrase dominates the other perfect phrases - ExPerfP (experiential perfect), UPerfP (universal perfect), and EPerfP (perfect of result) -, described by Nespoli (2018) and Rodrigues (2019). It is thus proposed that the RecPerfP phrase would be pruned in the investigated patients.

We emphasize that the acronym EPerfP refers to the phrase of existential perfect, as postulated by Nespoli (2018). However, Rodrigues (2019) points out that such a phrase concerns the resultative value. Taking into consideration that the term "existential" also encompasses the perfect of recent past and experiential types, we believe that such acronym is not appropriate. Therefore, in order to avoid ambiguity in explaining the hierarchy among the perfect phrases, we propose that the reference to the resultative type in the inflectional layer should be ResPerfP.

Furthermore, it is possible to observe that the LPPA patient has a deficit that also affects the tense category, more specifically, the present tense. We believe, also in the framework of the Tree Pruning Hypothesis (FRIEDMANN; GRODZINSKY, 1997), that this fact provides evidence for the discussion about the position of the tense phrase (TP) concerning the perfect phrases in the syntactic representation. Authors such as Alexiadou, Rathert, and Von Stechow (2003), Iatridou, Anagnostopoulou and Izvorski (2003), and Nespoli (2018) advocate that TP dominates the perfect phrase(s), while Rodrigues (2019) argues that TP is dominated by such phrases. Since tense is compromised in the LPPA patient without other types of perfect, besides the mentioned above, being affected, it seems plausible to assume that TP is in higher positions in the syntactic tree, having been similarly pruned. Therefore, we argue that TP dominates the perfect phrases.

Although we have no evidence through the data obtained in this study to guarantee the dominance of TP over RecPerfP, it seems appropriate to assume such a configuration. In other words, in accordance to the authors mentioned in the previous paragraph, who argue that TP dominates the perfect phrases, we assume that the four perfect phrases are close to each other in the syntactic tree, being dominated by the tense phrase.

Regarding the perfective / imperfective aspect phrase (AspP), all the proposals described by the aforementioned authors defend that it is found below the perfect phrases. The data obtained in this paper does not provide evidence for refuting such a claim, since it meets such a proposition. We understand, therefore, that the syntactic hierarchy established among the tense, perfective/imperfective aspect, and perfect phrases is as follows: TP > RecPerfP > UPerfP > ExPerfP > ResPerfP > AspP. Thus, in the patient with LPPA, the pruning of the tree would happen in RecPerfP, affecting this phrase along with TP, while in the patient with AD, the pruning would happen in AspP, also affecting all the phrases above.

Further, it is remarkable that the AD patient, regarding the two basic grammatical aspects, presented a deficit with the imperfective aspect, but not with the perfective aspect. This panorama resembles that found in other studies on aspectual language impairment, such as those by Martins (2010), on native Brazilian Portuguese speakers diagnosed with AD, Fyndanis *et al.* (2012), on native Greek speakers diagnosed with AD, and Braga (2004), on native Brazilian Portuguese speakers diagnosed with Broca's Aphasia.

Taking into account the results obtained in this study, we can now conclude on the hypotheses formulated for this research. Hypothesis (i), which predicted that there would be an impairment in the linguistic expression of perfect, when associated with present tense, of individuals diagnosed with AD and LPPA who are native speakers of BP, was not refuted, because, in the data obtained with the application of the tests to the two patients,

an impairment with the perfect was observed, either more restricted, as in the patient with LPPA, or more extended, as in the patient with AD. Hypothesis (ii), which predicted that the impairment in the linguistic expression of the perfect, when associated with the present tense, in native BP-speaking individuals diagnosed with AD would be selective, not affecting all of its types, was refuted since the patient with AD presented a deficit that affected all types of perfect. Hypothesis (iii), which predicted that the impairment in the linguistic expression of the perfect associated with the present tense in native BP-speaking individuals diagnosed with LPPA would not be selective, affecting all of its types, was also refuted since the patient presented a deficit that affected only existential / perfect of recent past.

Moreover, it should be noted that the lower compromise of tense and aspect categories in the LPPA patient seems to derive from the fact that the initial linguistic deficits in this pathology are not syntactic by nature, and are usually associated with repetition and anomie problems.

Lastly, we emphasize that the major impairment in the linguistic expression of the two patients is found in the existential perfect / perfect of recent past. We hypothesize that this is related to the inherent nature of Alzheimer's disease. In AD, the initial deficit consists of difficulty in retaining information in short-term memory, making it impossible for a recent memory to be sent to long-term memory. In LPPA, although the initial deficit is exclusively linguistic, with memory damage in later stages, in the case of the patient with LPPA participating in this study, the memory was already impaired according to the results of this MMSE category. Thus, it seems to us that both variants cause difficulty in retaining the recent past, a characteristic notion of this type of perfect. In this case, therefore, we would also have the possibility of interpreting that the linguistic performance related to the perfect of recent past compromised in the patients is not necessarily due to an impediment with the linguistic feature contained in RecPerfP, but may be a result of their difficulties in retaining information related to the recent past.

4. CONCLUSION

This study aimed to investigate the syntactic representation of the perfect through a possible linguistic impairment of this aspect in Alzheimer's disease, both in AD and LPPA, through a double case study. The results of the research provided evidence for discussion about dissociation of the existential / perfect of recent past in the mental grammar. It was advocated for the existence of a phrase encompassing such knowledge, the RecPerfP. This would be dominated by the tense phrase, and would dominate the other perfect phrases, as well as the perfective/imperfective aspect phrase, in accordance to the

following hierarchy: TP > RecPerfP > ExPerfP > UPerfP > ResPerfP > AspP. It was also observed that the linguistic deficit in the AD patient was more extensive than that of the LPPA patient. It was discussed that such a panorama seems to be due to the degree of cognitive deterioration since the AD patient showed lower performance than the LPPA patient also in the functionality and neuropsychological tests.

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