Open Library of Humanities

Intervention effects in Catalan agrammatism

Io Salmons, Centre de Lingüística Teòrica, Universitat Autònoma de Barcelona, ES, io.salmons@uab.cat

Anna Gavarró, Centre de Lingüística Teòrica, Universitat Autònoma de Barcelona, ES, anna.gavarro@uab.cat

The goal of the present study is to test the agrammatic comprehension of clitic left dislocation and contrastive focus in Catalan, in order to evaluate the Generalised Minimality hypothesis of Grillo (2009). According to this hypothesis, the comprehension deficit observed in agrammatism is the result of the underspecification of scope-discourse features giving rise to generalised intervention effects. We conducted two sentence-picture matching tasks to assess the comprehension of clitic left dislocation and contrastive focus with nine and seven Broca's aphasic subjects, respectively, as well as control participants. The results show that the comprehension of SVO sentences and object clitics was preserved, whereas the comprehension of object dislocations and object focalisations was compromised. These findings are consistent with the analysis of the deficit as an instance of generalised intervention effects. Yet, we also examined the prediction that a relevant syntactic feature mismatch between the subject and the object would suffice to block generalised minimality effects; in particular, the number features of subject and object were controlled for. The agrammatic subjects' performance on mismatched sentences did not differ from their performance on sentences where the subject and the object were matched in number. These findings call the hypothesis into question and stress the need for future research.

1 Introduction

There is extensive experimental work on comprehension in Broca's aphasia across languages and methodologies. Most studies have focused on the interpretation of passives, object relatives and clefts or wh-questions, which have often been shown to be problematic for agrammatic aphasics (among others, Gavarró & Dotti 2014 for Catalan and Spanish; Nanousi & Terzi 2017 for Greek; Friedmann 2008 for Hebrew; Garraffa & Grillo 2008 for Italian; Beretta et al. 1996 for Spanish). The comprehension deficit observed in agrammatism has been explained as an instance of generalised minimality effects due to feature impoverishment by Grillo (2009). The few studies that have investigated feature representation in agrammatism focus mainly on the comprehension of relative clauses and wh-questions (Varlokosta et al. 2014; Sheppard et al. 2015; Friedmann et al. 2016; Adelt et al. 2017; Terzi & Nanousi 2018; Adelt et al. 2020); whereas the comprehension of other structures remain mostly unexplored. Furthermore, previous research on intervention effects in agrammatism has focused on case features whereas the studies on the role of other features are very scarce (Terzi & Nanousi 2018 for gender and Adelt et al. 2017; 2020 for number).

The present study aims at investigating the agrammatic comprehension of contrastive focus and clitic left dislocation in Catalan. These structures are highly productive in the Romance languages and involve several properties that constitute a critical test to the Generalised Minimality hypothesis (Grillo 2009). We introduce the investigation on the role of morphosyntactic features and, more specifically, number, in the formation or blocking of syntactic chains in the underlying aphasics' syntactic representations.

1.1 Generalised Minimality

The Generalised Minimality (GM hereafter) hypothesis was formulated by Grillo (2009) within the linguistic framework of Relativized Minimality (RM; Rizzi 1990; 2004). RM operates as a principle that restricts the possible syntactic chains in natural languages to local configurations. For example in (1), X and Y are able to stand in a local configuration if Z does not belong to the same structural type as X and cannot, therefore, act as a potential intervener.

(1)   … X … Z … Y …

Rizzi (2004) postulated four different classes of syntactic features –see (2a)–(2d)– related to specific morphosyntactic features associated with syntactic heads.

(2)   a.   Argumental: person, gender, number, case.
        b.   Quantificational: wh, focus…
        c.   Modifiers
        d.   Topic

For example, the displaced constituent *which boy* in (3a) can enter into a local configuration with its copy because they both belong to the same class (while *the girl* does not); whereas in (3b), an element of the same class between the antecedent and the copy intervenes, therefore minimality effects arise blocking the formation of the syntactic chain.

(3) a. [Which boy]$_{ClassQ}$ did [the girl]$_{ClassA}$ <the girl>$_{ClassA}$ kiss <which boy>$_{ClassQ}$?

 b.* [Which boy]$_{ClassQ}$ did [which girl]$_{ClassQ}$ <which girl>$_{ClassQ}$ kiss <which boy>$_{ClassQ}$?

According to Grillo (2009), the aphasics' representations are impoverished with respect to discourse-related morphosyntactic features due to a processing deficit.[1] As a result, moved elements are indistinguishable from intervening elements if they lack the relevant features that make them belong to a specific feature class. This is represented in example (4) (from Grillo 2008): the feature *wh* is underspecified (marked with an asterisk) and, as a consequence, the displaced object belongs to the same class as the subject, which stands between the object and its copy; hence, the subject intervenes and blocks the formation of the syntactic chain (marked with a question mark), disrupting the transmission of the thematic role. Therefore, by hypothesis the comprehension deficit observed in agrammatism is the result of generalised minimality effects.

(4) The boy$_i$ who$_i$ the girl$_j$ <...>$_?$ kissed <...>$_?$
    $(\theta_?,\phi_{sg},*)_{ClassA}$ $(\theta_?,\phi_{sg})_{ClassA}$ $(\phi_{sg},*)_{ClassA}$

The hypothesis is motivated by psycholinguistic studies that show that different linguistic levels are processed at different times, more specifically, that discourse information is processed at a later stage (Frazier 1998). Grillo (2009) interprets this in line with the movement hierarchy proposed by Abels (2007), according to which morphosyntactic features are merged earlier than scope-discourse features: that is, arguments are first merged in the corresponding thematic position, and move up to other syntactic positions later.

The claim is therefore that aphasic individuals are able to represent morphosyntactic features merged at an earlier stage, namely case, gender and number. Therefore, the presence of discrepant ϕ-features should suffice to link moved constituents to their copies (5). Yet, Grillo was aware of the fact that a mismatch of ϕ-features does not improve agrammatic comprehension (see Burchert et al. 2003; 2005a for case in German; Friedmann & Shapiro 2003 in Hebrew; Friedmann et al. 2010 in Russian), and explicitly stated that a gender or number mismatch alone "is not enough to avoid a minimality effect unless that feature introduces a change of class" (2009:1433). The relevant features are those that can act as attractors of syntactic movement, which is the case for

---

[1] The nature of this processing is unclear. Grillo (2008) reported previous studies on the online comprehension of aphasic individuals according to which processing was slower-than-normal (e.g. Burkhardt et al. 2008), and others that claimed that the processing cost was significantly higher when dealing with syntactic operations at a discourse level (Avrutin 2006; Vasic et al. 2006); yet, he did not exclude other possibilities (see Grillo (2009) for discussion).

number in Catalan as it is overtly expressed in the inflected verb and is part of the ϕ-complex that can function as an attractor and trigger the movement of the subject. The presence of mismatched number features between the subject and the object is therefore predicted to block minimality effects in sentences like the one in (5) in agrammatism. Hence, the GM hypothesis predicts that these structures will be well-comprehended by agrammatic aphasics:

(5)　　A LES SOLDATS$_i$　va mullar　el policia$_j$　　$<...>_j$　　　$<...>_i$
　　　　(ACC,θ_2,ϕ_{pl},*)$_{ClassA}$　v-3SG.PST　(θ_1,ϕ_{sg})$_{ClassA}$　(θ_1,ϕ_{sg})$_{ClassA}$　(ACC,θ_2,ϕ_{pl},*)$_{ClassA}$
　　　　'THE SOLDIERS, the policeman wetted.'

Further support for the relevance of the presence of certain features to avoid generalised minimality effects comes from some experimental work in acquisition, in which the poor comprehension of object relatives is also analysed as an instance of generalised minimality effects (see, among others, Friedmann et al. 2009; Adani 2010; Belletti et al. 2012), and also from studies on other types of aphasia (Martini et al. 2020).

2 The present study

Despite the fact that the basic word order in Catalan is SVO, there is a wide range of constructions that display noncanonical word orders, such as structures with topicalised (6) or focalised objects (7). In these cases, the movement of the object from its base position to the left periphery is triggered by a discourse-related feature. Furthermore, the overt subject can act as a potential intervener between the copy and the moved object, giving rise to generalised minimality effects. These phenomena can therefore contribute to evaluating Grillo's Generalised Minimality (2009).

2.1 Syntactic analysis of the relevant structures

Clitic left dislocation (hereafter CLLD; Rivero 1980; Cinque 1990; Rizzi 1990; Ott 2014) is a quite productive construction in Catalan. It involves a topicalised element –*el vi* 'the wine' in (6)– that undergoes movement to the left periphery (Rizzi 2004; Villalba 2009; López 2009; Rubio 2014), and a resumptive clitic that agrees with the topicalised element in number, gender and case –*el* in (6)–.

(6)　　El　　　vi$_i$,　el$_i$　　　　portarà　　　l'　　　Aurembiaix$_j$ $<...>_j$ $<...>_i$.
　　　　DET.M.SG　wine　CL.ACC.M.SG　bring-FUT.3.SG　DET.F.SG　Aurembiaix
　　　　'The wine, Aurembiaix will bring it.'

Focalised constructions can also present the focalised element in the left periphery –*EL VI* 'the wine' in (7)– , but they do not involve a resumptive element (Rizzi 2004; Cinque & Rizzi 2008):

(7)　　EL　　　VI$_i$　(no el　　　pa)　portarà　　　l'　　　Aurembiaix$_j$ $<...>_j$ $<...>_i$.
　　　　DET.M.SG　wine　NEG　DET.M.SG　bread　bring-FUT.3.SG　DET.F.SG　Aurembiaix
　　　　'THE WINE (not the bread), Aurembiaix will bring.'

Both structures have pragmatic import. Topicalisation is used to set apart the old information in an utterance, in order to emphasise that some new information –comment– about the topicalised constituent is going to be introduced (Bianchi & Frascarelli 2010). By contrast, focalisation is used to stress certain information, and especially to contrast new information with the presupposed belief of the listener (within parentheses in (7)).

The sentences above show the subject-object inversion typically observed in Catalan left-peripheral structures. Null-subject languages like Catalan are relatively permissive regarding the position of the subject. In fact, the position of preverbal and postverbal subjects in Romance languages has been a much-discussed topic in the syntactic literature (among others, Rizzi 1982; Suñer 2003; Villa-García 2013; and Bonet 1990; Solà 1992; Vallduví 1993 for Catalan). It is argued that discourse properties motivate the movement of the subject (Belletti 2001) from the VP-internal position: postverbal subjects to the [Spec, FocP] position (Ordóñez 2007), and preverbal subjects to an A'-position higher than [Spec, TP] where they are interpreted as topics (Solà 1992; López 2009).

In the present study declaratives and subject topicalisations and focalisations displaying the canonical SVO word order were also included as control items. The same word order can therefore be found in declaratives, topicalisations and focalisations, and the only overt marker differentiating these structures in Central Catalan is the intonational contour (Prieto 2002). Therefore, prosody plays a crucial role in the interpretation of these structures. The intonational contour of neutral declaratives is a general falling F0 (L+ >H*L*L%). The topic, on the other hand, constitutes an independent unit isolated from the rest of the utterance and is realized by a rising F0 (L+H*H%), which is the typical frequency to leave the utterance unfinished and introduce a new prosodic unit whose content depends on the first one. The second unit, the comment, is characterised by a falling contour (L*L%). In contrast, the contrastive focus is prosodically marked by a prominent accentuation of the focused item by a rising low F0: after the high peak, the F0 falls immediately to reach a low frequency (L+H*L%). The rest of the utterance is realized with a falling F0 (L*L%). There are some studies showing that individuals with aphasia are able to discriminate different intonational contours (among others, Gavarró & Salmons 2013 for Catalan, Burchert et al. 2005b and Raithel 2005 for German).

2.2 Previous research

To our knowledge, the only study on the comprehension of Romance CLLD in agrammatism was carried out by Beretta et al. (2001). The authors conducted a sentence-picture matching task with two Spanish-speaking Broca's aphasics including declaratives and clitic left dislocations with preverbal subjects. The declarative sentences were well-comprehended by the two patients (mean of 75% and 85% of correct responses, respectively). However, their performance on CLLD was not as consistent, given that one of the subjects reached a 75% of correct responses,

whereas the other subject performed very poorly (35% of correct responses). Considering the overall performance on the CLLD condition, the authors concluded that the interpretation of this structure was compromised in agrammatism.

Other studies have investigated the agrammatic interpretation of syntactic constructions that involve movement of constituents and resumptive clitics, such as Jovanov (2011) for Serbian and Greek dislocations, and Friedmann (2008) for Hebrew relative clauses. In both cases, the aphasic participants failed to comprehend the sentences with the displaced direct object despite the presence of the resumptive clitic.

Studies on the agrammatic comprehension of clitics in Romance are less scarce. The comprehension of object clitics has been shown to be unimpaired in Catalan (Gavarró 2008), Galician (Martínez-Ferreiro 2010), Italian (Luzzatti et al. 2001) and Spanish (Baauw & Cuetos 2003), as is also the case for indirect object clitics (Luzzatti et al. 2001 for Italian and Salmons 2015 for Catalan). However, the focus of interest of most of these studies lay rather on whether aphasic individuals interpreted clitics as pronouns or as reflexives; for this reason, the experimental designs did not include role-reversals as distractors. The only exception is the study carried out by Luzzatti et al. (2001), who reported that 11 Italian-speaking agrammatic subjects reached a 75.5% of correct responses in a sentence-picture matching task that tested the comprehension of object clitics.

Several studies have investigated the comprehension of object focalisations in agrammatism, and have found robust results across languages which indicate that the aphasic subjects' interpretation of such structures is impaired (Catalan: Gavarró (2005); German: Burchert et al. (2003); Greek and Serbian: Jovanov (2011); Hebrew: Friedmann & Shapiro (2003): Russian: Friedmann et al. (2010), among others). Most of these studies included languages that have morphologically overt case markers, which did not help the aphasic participants to interpret object focalisations.

On the other hand, the research on feature representation in agrammatism and how it may interact with the comprehension deficit focuses mostly on the role of case on other types of syntactic construction, namely relative clauses and wh-questions (Varlokosta et al. 2014; Sheppard et al. 2015; Adelt et al. 2017; Terzi & Nanousi 2018; Adelt et al. 2020).

Friedmann et al. (2016) investigated the role of case in the interpretation of Hebrew object focalisations by seven agrammatic subjects who performed at chance in a sentence-picture matching task. The authors interpreted the results as evidence that aphasic individuals were sensitive to the accusative marker[2] but were unable to use it as a comprehension cue, given that

---

[2] Friedmann et al. (2016) assume that an at-chance performance on object topicalisations entails that the aphasic subjects are sensitive to the accusative marker, whereas a below-chance performance would indicate that they were not sensitive to the overt marker and, as a consequence, tended to interpret object focalisations as SVO sentences. Similarly, case has been claimed to improve the aphasics' interpretation of relatives clauses in other languages (Adelt et al. (2017) and Adelt et al. (2020) for German object relatives, Kljajevic & Murasugi (2010) for wh-questions in Croatian, and Terzi & Nanousi (2018) for Greek subject relatives).

this morphosyntactic feature does not attract movement in Hebrew and, hence, it is irrelevant in terms of blocking minimality effects (in line with what Grillo (2009) argued).

Terzi & Nanousi (2018) investigated whether gender had any effect on the comprehension of relative clauses in agrammatism. They conducted an experimental task with six aphasic participants on the comprehension of Greek relative clauses. The aphasic participants' comprehension of subject relatives was good, whereas the comprehension of object relatives was poor. Terzi & Nanousi (2018) investigated whether gender had any effect on the comprehension of relative clauses in agrammatism. Despite the fact that gender is not a criterial feature in Greek, gender had an effect in intervention effects, since the aphasic subjects performed significantly better on object relatives where the subject and the object mismatched in gender (mean of 68.75% of correct responses) than on those sentences with matched gender (mean of 43.05% of correct responses).

To our knowledge, there is only one study on how a relevant criterial feature, number, may interact with the comprehension deficit: Adelt et al. (2017) conducted a task on the comprehension of German relative clauses and, interestingly, the aphasic participants only reached a mean of 60.6% and 59.4% of correct responses on subject and object relatives, respectively, when they presented mismatched number between the subject and the object. Number is a syntactically active feature in German and is predicted to block minimality effects by the GM, but that prediction does not seem to be fulfilled. The fact that the aphasic sample was very heterogeneous (5 Broca, 4 anomic and 1 unspecified aphasic participants) could have influenced the results.

In this connection, it has often been observed in the agrammatic literature that there is variability in performance among subjects through different types of structures. This led some researchers to claim that agrammatic aphasia is too broad to be associated with specific patterns of disruption (Beretta et al. 1996; Caramazza et al. 2001), and gave rise to a debate on the legitimacy of group studies and hypotheses that attempt to characterise Broca's aphasia as a uniform syndrome. Variability is especially apparent when samples are small.

In fact, there is wide evidence that agrammatic aphasics tend to reproduce general patterns of performance across methodologies and languages (Grodzinsky et al. 1999; Drai 2006; Grodzinsky 2010) in spite of the variability among subjects. Drai and Grodzinsky (2006a; 2006b), for example, analysed data from sixty-nine aphasic patients with a new method that allowed quantification of individual variation and the analysis of group performance, and the results revealed that general patterns of response could still be observed across tasks and languages, and that they mainly concerned syntactic structures that involved movement. Neuroimaging studies with healthy subjects also revealed that minimal contrasts involving these type of sentences – but not other syntactic constructions (Santi & Grodzinsky 2007)– consistently activated the left

inferior frontal gyrus (Santi and Grodzinsky 2010; 2012; Grodzinsky et al. 2021), which has been argued to be damaged in Broca's aphasia (Geschwind 1970).

2.3 Goals and predictions

Hence, more research is needed given that the few studies on the morphosyntactic representation and intervention effects in agrammatism report diverging results. In what follows we present two experiments targeting the agrammatic comprehension of clitic left dislocation and contrastive focus in Catalan to evaluate the hypothesis that the deficit in agrammatic aphasia is an instance of generalised minimality effects (Grillo 2008), and to examine whether a relevant feature in Catalan like number can block intervention effects as hypothesised by the GM. On the basis of the theoretical framework outlined, the predicitions on the performance of subjects with agrammatic aphasia on the syntactic constructions evaluated appear in **Table 1**, where potential interveners are underlined. Under the GM hypothesis, no differences in performance are predicted between object topicalisations and focalisations with pre- and postverbal subjects,[3] despite that OSV sentences involve one more movement operation: the subject acts as a potential intervener between the displaced object and the copy in both type of sentences when there is a match of ϕ-features between the subject and the object (8a) and, hence, generalised minimality effects arise. By contrast, mismatched OVS dislocations and focalisations are predicted to be well-comprehended.

Sentence type			Predicted performance	
			Matched	**Mismatched**
Declarative	SVO	El policia$_i$ va mullar t_i les soldats.	good	good
Object clitics	SclV	El policia$_i$ les$_j$ va mullar t_i t_j	good	good
Focalisation	SVO	EL POLICIA$_i$ va mullar t_i les soldats.	good	good
	OSV	A LES SOLDATS$_i$ el policia$_j$ va mullar t_j t_i	poor	good
	OVS	A LES SOLDATS$_i$ va mullar el policia$_j$ t_j t_i	poor	good
Dislocation	SVO	El policia$_i$, va mullar t_i les soldats.	good	good
	OSclV	A les soldats$_i$, el policia$_j$ les$_i$ va mullar t_j t_i t_i	poor	good
	OclVS	A les soldats$_i$, les$_i$ va mullar el policia$_j$ t_j t_i	poor	good

Table 1: Summary of the predictions of the GM hypothesis.

---

[3] Grillo (2008) also derives the same predictions to explain the at-chance performance observed in a study on the comprehension of Hebrew OSV and OVS conducted by Friedmann & Shapiro (2003).

3 Experiment I: clitic left dislocation

The goal of the first experiment was to test the prediction that, according to the GM hypothesis, the agrammatic comprehension of CLLDs in Catalan is poor when the subject and the object match in number (8a), but preserved when they are mismatched (8b).

(8) a. Al cocodril$_i$ el$_?$ va colpejar   el mico $<...>_?$
         $(\theta_?,\phi_{m.sg},{}^*)_A$ CL.M.SG   V $(\theta_1,\phi_{m.sg})_A$ $(\theta_2,\phi_{m.sg},{}^*)_A$
         'The cocodrile, the monkey hit him.'

   b. A les soldats$_i$, les$_i$ va mullar el policia $<...>_i$
         $(\theta_2,\phi_{pl},{}^*)_A$ CL.F.PL V $(\theta_1,\phi_{sg})_A$ $(\theta_2,\phi_{pl},{}^*)_A$
         'The soldiers, the policeman wetted them.'

3.1 Methods

3.1.1 Participants

Nine agrammatic individuals, and nine age- and education-matched control subjects participated in the task. The aphasic subjects were selected from the patient pool of the *Associació Sant Pau de Trastorns de la Comunicació* (Barcelona). They were all diagnosed via the Spanish version of the Western Aphasia Battery (Kertesz et al. 1990) by speech pathologists and neurologists in the medical centers where they were treated after left-hemisphere damage. All subjects were right-handed and native speakers of Catalan, and none of the participants had a history of drug abuse, hospitalisation for psychiatric disorders, speech/language disorders or learning disabilities before the stroke. Details of etiology and aphasia type (as judged by the medical team), and time post-onset collected from the medical health records appear in **Table 2**. The nonverbal cognitive skills of participants were not assessed.

Subject	Age	Education	Lesion site	Etiology	TPO (years)	Aphasia
A1	38	2	FT	HCVA	8	Broca
A2	37	3	LF	CVA	12	Broca
A3	71	3	LMCA	ICVA	14	Broca
A4	71	3	LMCA	ICVA	13	Broca
A5	60	2	LF	ICVA	4	Broca
A6	68	1	LF	ICVA	6	Broca
A7	69	1	LF	CVA	6	Broca
A8	48	2	LCMA	ICVA	15	Broca
A9	78	3	LMCA	ICVA	15	Broca

Table 2: Individual characteristics of subjects with agrammatism in Experiment I.

3.1.2 Materials

The task consisted of five different conditions containing twenty items each: declaratives (9a) and subject topicalisations (9b) as control items, clitic left dislocations with preverbal subjects (9c), clitic left dislocations with postverbal subjects (9d), and active sentences with direct object clitics (9e).

(9)   a. El   policia   va   mullar a   les   soldats.
             DET.M.SG policeman AUX.3SG.PST wet-INF to-ACC DET.F.PL soldier-PL
             'The policeman wetted the soldiers.'

          b. El   policia,   va mullar a   les   soldats.
             DET.M.SG policeman   to-ACC DET.F.PL soldier-PL
             'The policeman, he wetted the soldiers.'

          c. A   les   soldats,   el   policia   les   va mullar.
             to-ACC DET.F.PL soldier-PL DET.M.SG policeman CL.ACC.F.PL
             'The soldiers, the policeman wetted them.'

          d. A   les   soldats,   les   va mullar el   policia.
             to-ACC DET.F.PL soldier-PL CL.ACC.F.PL   DET.M.SG policeman
             'The soldiers, the policeman wetted them.'

          e. El   policia   les   va mullar.
             DET.M.SG policeman CL.ACC.F.PL
             'The policeman wetted them.'

All sentences contained frequent nouns and verbs, and were simple, semantically reversible and of similar length (between 5 and 8 words). In half of the items, the subject and object did not match in number (and gender) –see examples in (9)–, whereas the other half presented a match of ϕ-features between the subject and the object (8a). In addition, each token was introduced by a contextualising sentence[4] introducing the characters depicted, as exemplified in (10), in order to make sure that the use of topicalisations and object clitics was felicitous.

(10)   Ahir vaig veure al policia i a les soldats. Jo no vaig fer res al policia. En canvi, les soldats el van mullar.
        'Yesterday, I saw the policeman and the soldiers. I didn't do anything to the policeman. However, the soldiers wetted him.'

Note that objects are preceded by a colloquial accusative marker, the preposition *a*. The use of an accusative marker with animate objects (differential object marking: DOM, hereafter) in

---

[4] An anonymous reviewer pointed out that the aphasics' working memory abilities, if impaired, could have affected their performance given the presence of the contextualising sentence. However, if this had been the case, we would have observed the effect on all conditions as they were all preceded by a contextualising sentence.

declarative sentences is extended in colloquial Catalan (Sancho 2002), though it is not normative (GIEC, 2016). When the object is displaced to the left periphery, the use of the accusative marker is standard for interpretative reasons (Solà 1994). However, the DOM is not indispensable for the interpretation of CLLD, since the presence of the clitic alone suffices to disambiguate dislocations.

3.1.3 Procedure

The experiment with agrammatic patients was run on a laptop, with loudspeakers, in a quiet room of the *Associació Sant Pau de Trastorns de la Comunicació* (Barcelona), while the experimental tasks with healthy subjects were conducted at locations convenient to the participants. Prior to the task, the experimenter interviewed all the participants to collect relevant personal information, and then the task was explained. The experimental design consisted of a sentence-picture matching task: participants were asked to listen carefully to the sentences and choose the matching picture between two alternatives printed on a sheet: the target picture and a theta role reversal (see **Figure 1**). Some trials were presented as examples before running the experiment to ensure that the participant had understood the task.

Figure 1: Example of the pictures presented for (8a) in Experiment I.

Sentences were prerecorded in a studio in order to preserve the characteristic intonational contour associated with Catalan topicalisations, and were reproduced through loudspeakers; also, tokens were presented in a pseudorandom order and could be played more than once if requested.

3.2 Statistical analysis

Statistical analyses were performed using SAS software, version 9.2 (SAS Institute Inc., USA). Nonparametric tests were used given that the distribution of the data was not normal. A logistic regression model for binomial data was performed to model the probability of success, and to calculate the odds ratio and 95% confidence intervals considering group and sentence type. Also, a standard goodness of fit test was conducted to calculate and compare the individual estimated

proportions of correct responses with a random pattern of response in order to learn whether the performance of the participants was at chance. Statistical significance was set at $p < 0.05$.

3.3 Results

The control participants performed at ceiling on all sentence types, whereas the aphasic performance varied across conditions (**Table 3**). The aphasic group reached high percentages of correct responses on control items, that is, declaratives and subject topicalisations. However, the logistics regression analysis determined that the performance of control and aphasic participants on these two conditions differed significantly (OR = 6.56, 95% CI [1.89, 22.77]) for declaratives and OR = 46.32, 95% CI [4.92, 54.13] for subject topicalisations). Regarding the comprehension of direct object clitics, aphasic participants reached a 80.6% of correct responses. Hence, object clitics were well interpreted, though their comprehension was significantly poorer than the control's performance (OR = 21.48, 95% CI [5.06, 91.28]) for controls vs aphasics). On the other hand, agrammatic subjects reached lower percentages of correct responses in the two dislocation conditions: patients showed a mean percentage of 48.9% of correct responses on CLLDs with postverbal subjects, whereas their performance on CLLDs with preverbal subjects was much better (mean of 67.8% of correct responses). The performance between control and aphasic participants also differed in these two conditions, the odds ratio of the control group being 46 and 21 times higher than the aphasics' on dislocations with postverbal (95% CI [7.37, 59.35]) and preverbal subjects (95% CI [16.31, 129.73]), respectively.

Group	SVO decl	SVO top	OSclV	OclVS	SclV
Control	177/180	177/180	176/180	176/180	178/180
	98.4%	98.4%	97.8%	97.8%	98.9%
Aphasic	162/180	141/180	122/180	88/180	145/180
	90%	78.4%	67.8%	48.9%	80.6%

Table 3: Correct responses by condition and group in Experiment I.

Even though the aphasic performance was on average slightly worse than the controls' performance through all conditions, the patients showed a good comprehension of declaratives, subject topicalisations and object clitics (estimated means of correct responses: 0.9, 95% CI [0.83, 0.94]; 0.78, 95% CI [0.69, 0.85] and 0.81, 95% CI [0.72, 0.87], respectively).[5] Regarding the comprehension of dislocations, the aphasic performance on dislocations with preverbal subjects differed significantly from their performance on CLLDs with postverbal subjects (estimated

---

[5] An anonymous reviewer points out that knowledge of the subject position might suffice to identify the right picture in the case of SclV sequences, without actual understanding of the clitic. However, this interpretation is not consistent with the results in Experiment II; see the discussion.

means of 0.68, 95% CI [0.58, 0.76] and 0.49, 95% CI [0.39, 0.59], respectively), as the former were better comprehended than the latter. This was also confirmed by the odds ratio: OR = 2.2, 95% CI [1.43, 3.38]. Nevertheless, the comprehension of CLLDs with preverbal subjects was significantly worse than the comprehension of declaratives (OR = 0.23, 95% CI [0.13, 0.42]), object clitics (OR = 0.46, 95% CI [0.25, 0.85]), and subject topicalisations (OR for SVO vs OSclV topicalisations = 1.72, 95% CI [1.07, 2.76]).

Since variability among subjects was observed (**Table 4**), the individual estimated proportions of correct responses were compared with a random pattern of response in order to learn whether aphasics' performance could be at chance. This allowed us to determine if the performance was good –above chance– or poor –at or below chance– in order to evaluate the predictions of the GM hypothesis. The p-values from the GOF test for all the conditions are represented in **Figure 2**: p-values lower than 0.05 –marked with a line in the graph– indicate that the null hypothesis that the aphasics' performance presents a random distribution is to be ruled out. The test revealed that the guessing performance can be ruled out for all patients in the declarative condition. Regarding the comprehension of subject topicalisations, seven out of nine patients showed an above-chance performance, while two patients, A8 and A9, performed at chance. The aphasic subjects' performance on object clitics was also above chance, except for three patients whose performance was at chance. Guessing performance cannot be ruled out for most aphasic subjects' performance on both dislocation conditions: on the one hand, eight out of nine patients performed at chance in the OclVS condition, and the other one below chance; and on the other hand, six patients showed an at-chance performance in OSclV dislocations while the other three performed above chance.

Sentence type	Maximum	A1	A2	A3	A4	A5	A6	A7	A8	A9
SVO decl	20	18	18	15	20	20	16	20	18	17
SVO top	20	15	17	16	20	17	17	16	11	12
OSclV	20	10	16	14	19	12	18	11	12	10
OclVS	20	14	10	12	10	14	7	5	8	8
SclV	20	17	19	13	20	15	18	19	10	14

Table 4: Correct responses by condition, subjects with aphasia, Experiment I.

Concerning the impact of mismatch of the relevant ϕ-features –number– between the subject and the object in comparison with the comprehension of matched sentences, the overall results showed that there were no statistically significant differences between matched and mismatched sentences (estimated means of correct responses: 0.72, 95% CI [0.64, 0.79] and 0.79, 95% CI [0.72, 0.85], respectively). The correct percentages by condition and sentence type are

represented in **Figure 3**; the odds ratio analysis revealed that significant differences between matched and mismatched sentences are only found in the object clitic condition (OR = 0.45, 95% CI [0.21, 0.97]), despite the fact that the aphasic performance on this condition was above chance (estimated means of 0.75, 95% CI [0.62, 0.84] for matched sentences and 0.87, 95% CI [0.77, 0.93] for mismatched sentences). No statistically significant differences were found between matched and mismatched sentences in dislocation conditions (OR = 0.74, 95% CI [0.39, 1.38] for OSclV and OR = 0.59, 95% CI [0.32, 1.06] for OclVS); thus, the presence of the clitic, and the number mismatch did not prevent aphasic participants from performing poorly in the task.
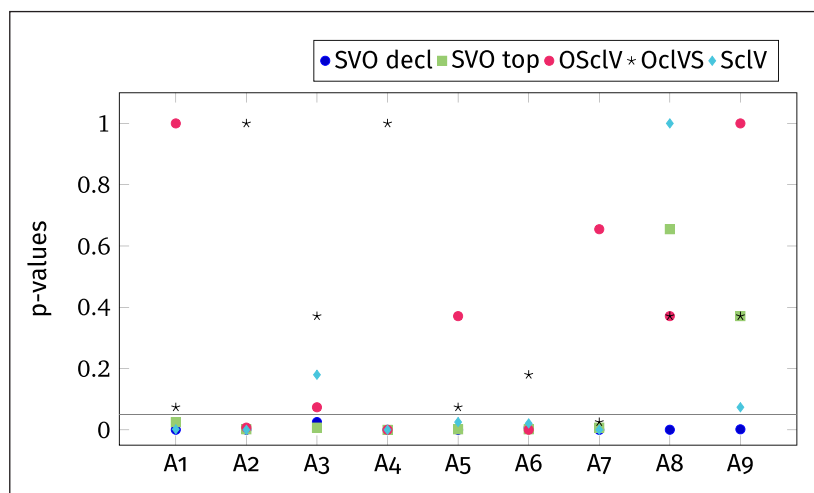

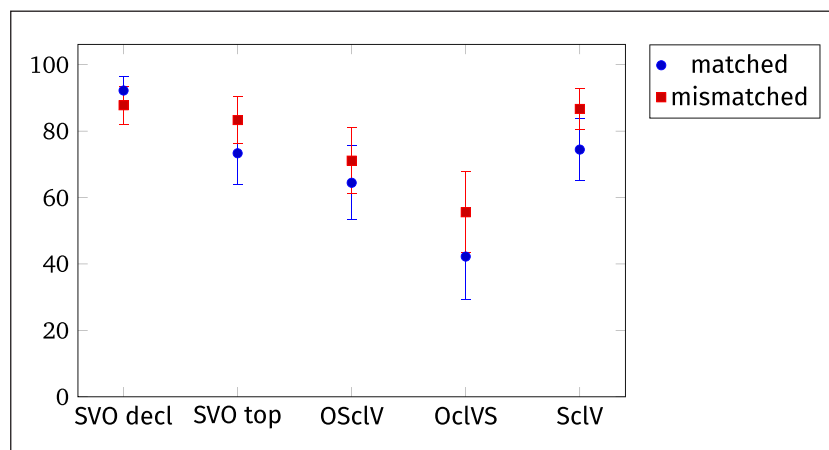**Figure 2:** Aphasic individuals p-values by condition from the GOF test in Experiment I.

Figure 3: Estimated means and confidence intervals of correct responses by condition and sentence type (aphasic subjects) in Experiment I.

3.4 Interim summary

To summarize, we conducted a sentence-picture matching task to test the comprehension of left clitic dislocation and object clitics in Catalan. The nine individuals diagnosed with Broca's aphasia that participated in the study showed a good performance on declaratives (9a), subjects topicalisations (9b) and sentences with object clitics (9e). In contrast, their performance on clitic left dislocations with preverbal (9c) and postverbal (9d) subjects was impaired. Also, intersubject variability was observed, specially on dislocations and object clitics. The study aimed at evaluating the GM hypothesis, according to which the comprehension of matched CLLD is predicted to be poor (8a), whereas the comprehension of mismatched dislocations is predicted to be good (8b). The statistical analysis, however, revealed that there were no significant differences between matcheded and mismatched dislocations, against the hypothesis' predictions.

4 Experiment II: contrastive focus

The goal of the second experiment was to evaluate the agrammatic comprehension of contrastive focus in Catalan, which was tested through a sentence-picture matching task, and to test the prediction that object focalisations will be well-comprehended by agrammatic aphasics if the subject and the object do not match in number:

(11)   ALS PALLASSOS$_i$ va banyar la nena$_j$ $<...>_j$ $<...>_i$
        $(\theta_2,\phi_{pl},{}^*)_A$ v $(\theta_1,\phi_{sg})_A$ $(\theta_1,\phi_{sg})_A$ $(\theta_2,\phi_{pl},{}^*)_A$
        'THE CLOWNS, the girl bathed.'

4.1 Methods

4.1.1 Participants

Seven aphasic individuals participated in the task. The patients were selected from the patient pool of the *Associació Sant Pau de Trastorns de la Comunicació* (Barcelona), and they were diagnosed via the Spanish version of Western Aphasia Battery (Kertesz et al. 1990) by speech pathologists and neurologists in the medical centers where they were treated after left hemisphere damage. All the participants were native speakers of Catalan and right-handed, and none of them had a history of drug abuse, hospitalisation for psychiatric disorders, speech/language disorders or learning disabilities before the stroke. Details of etiology, aphasia type and time post-onset collected from the medical health records appear in **Table 5**. In addition, the task was conducted with seven age- and education-matched control participants. Nonverbal cognitive abilities were not assessed.

Subject	Age	Education	Lesion site	Etiology	TPO (years)	Aphasia
A1	70	3	LMCA	CVA	3	Broca
A2	41	2	LFT	HCVA	15	Broca
A3	72	3	LMCA	ICVA	14	Broca
A4	80	1	MCA	ICVA	17	Global
A5	72	3	LMCA	ICVA	17	Broca
A6	38	2	FT	HCVA	9	Broca
A7	61	2	FT	HCVA	15	Broca

Table 5: Agrammatic subjects' individual characteristics in Experiment II.

4.1.2 Materials

The experimental task consisted of four conditions with fourteen items each (total of 56 items). The materials included declaratives (12a) and subject focalisations (12b) as control items, and two types of object focalisations: with preverbal (12c) and postverbal subjects (12d). In contrast with the CLLDs included in the previous task, object focalisations do not involve a resumptive clitic. In this case all items presented mismatch of number (and gender) between the subject and the object. Had they presented matched features, the sentences would have been ambiguous in Catalan.

(12) a. La   nena va   banyar   als   pallassos.
          DET.G.SG girl   AUX.3SG.PST bath-INF to-ACC DET.M.PL clown-M.PL
          'The girl bathed the clowns.'

      b. LA   NENA va   banyar   als   pallassos.
          DET.G.SG girl   AUX.3SG.PST bath-INF to-ACC DET.M.PL   clown-M.PL
          'THE GIRL bathed the clowns.'

      c. ALS   PALLASSOS la   nena va   banyar.
          to-ACC-DET.M.PL clowns-M.PL DET.F.SG girl   AUX.3SG.PST wet-INF
          'THE CLOWNS the girl bathed.'

      d. ALS   PALLASSOS va   banyar   la   nena.
          to-ACC-DET.M.PL clowns-M.PL AUX.3SG.PST bath-INF DET.F.SG girl
          'THE CLOWNS the girl bathed.'

Unlike in former work (Friedmann & Shapiro 2003; Burchert et al. 2005a; Friedmann et al. 2010; Maviş et al. 2019), the items were contextualised to justify the use of a contrastive focus contour: each trial consisted of a brief conversation between two speakers, the first one uttering a sentence with incorrect information involving a third character (13a), and the second speaker correcting the first one (13b). The first speaker's error always involved a lexical foil, as it has been shown that this type of foil is not problematic for agrammatic aphasics (Caramazza & Zurif 1976).

(13) a. *Speaker A*: La   nena va   banyar als   infermers.
                      DET.F.SG girl   AUX.3SG.PST bath-INF DET.M.PL nurse-M.PL
            'The girl bathed the nurses.'

   b. *Speaker B*: No. ALS   PALLASSOS va   banyar la   nena.
                     NEG DET.M.SG nurse-M.PL   DET.F.SG girl   AUX.3SG.PST bath-INF
            'No. THE CLOWNS, the girl bathed.'

Like in the previous experiment, all sentences were simple, semantically reversible, and similar in length. Also, all the items presented the colloquial accusative marker (the preposition *a*) preceding the direct object.

4.1.3 Procedure

The experimental task was conducted in a quiet room with loudspeakers in the *Associació Sant Pau de Trastorns de la Comunicació* (Barcelona) with agrammatic subjects, and at their homes with control participants. Before starting with the experiment, the participants were told about the task, and some trials were presented as examples in order to ensure that it was comprehended. The items were presented in a pseudorandom order, and they could be played more than once. There were no limitations of time to complete the task.

Since the experimental task was a sentence-picture matching task, participants were shown two pictures and were asked to listen carefully to a sentence and point to the picture that matched it. See an example of an object focalisation with a postverbal subject in (13b) for the materials in **Figure 4**, in which the three characters mentioned in the conversation are represented. Like in the previous experiment, one picture represented the correct interpretation and the other one the theta role reversal foil. Agent characters were placed both on the left and on the right to control for any bias resulting from picture paralleling the order of mention of subjects and objects. The materials were prerecorded in a studio in order to preserve the characteristic intonational contour associated with contrastive focus; and the pictures were shown on a laptop screen.
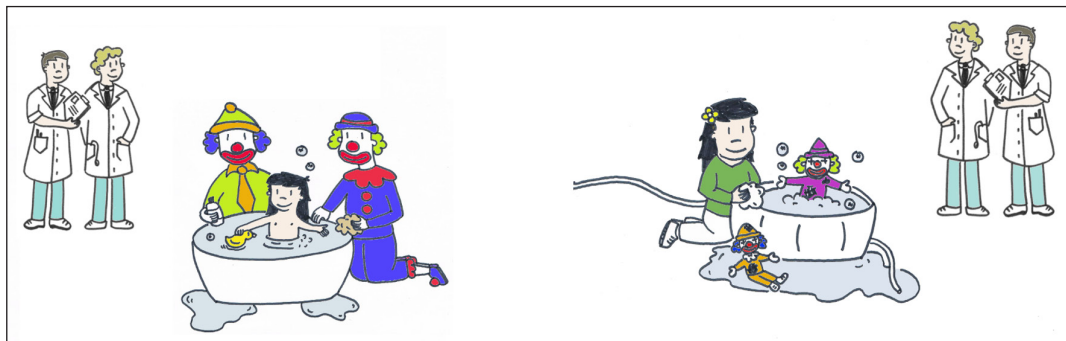

Figure 4: Example of the pictures presented in Experiment II.

4.2 Results

The statistical analysis conducted is described in section 3.2. The control subjects performed at ceiling on all conditions, whereas the aphasic individuals only reached a high percentage of correct responses in the declarative and subject focalisation conditions (see **Table 6**). In fact, there were no statistically significant differences between groups in these two conditions, as the odds ratio revealed (OR = 5.22, 95% CI [0.54, 50.33] for declaratives and OR = 2.38, 95% CI [0.59, 9.47] for subject focalisations). The aphasics' performance on object focalisations was much lower, and the statistical analysis indicated that the control and aphasic performances differed significantly in both conditions (OR = 101.04, 95% CI [12.16, 839.95] for object focalisations with preverbal subjects and OR = 22.56, 95% CI [6.38, 79.80] for object focalisations with postverbal subjects).

Group	SVO decl	SVO foc	OSV foc	OVS foc
Control	97/98	94/98	97/98	94/98
	99%	95.9%	99%	95.9%
Aphasic	93/98	89/98	48/98	50/98
	94.9%	90.8%	49%	51%

Table 6: Correct responses by condition and group in Experiment II.

Concerning the aphasics' responses by sentence type, the statistical analysis revealed that the difference in performance between the OVS and OSV focus conditions was not significant (OR = 1.09, 95% CI [0.52, 2.27]), and neither was the difference between declaratives and subject focalisations (OR = 1.88, 95% CI [0.43, 8.31]). On the other hand, the aphasics' performance on the two object focalisations differed significantly from the declarative and subject focalisation conditions, as the odds ratio indicated: OR = 17.86, CI (4.91, 64.96) for declaratives vs OVS focus, OR = 19.38, 95% CI [5.33, 79.48] for declaratives vs OSV focus, OR = 9.49, 95% CI [3.36, 26.86] for subject focus vs OVS focus, and OR = 10.30, 95% CI [3.64, 29.15] for subject focus vs OSV focus.

The pattern of response described above is reproduced individually (**Table 7**), except for patient A1, who showed an almost normal performance on all conditions.

Sentence type	Maximum	A1	A2	A3	A4	A5	A6	A7
SVO decl	14	13	13	14	13	14	12	14
SVO foc	14	13	14	13	13	13	10	13
OSV foc	14	13	4	9	1	7	6	7
OVS foc	14	12	2	6	4	8	11	8

Table 7: Correct responses by condition in Experiment II (aphasic group).

A standard goodness of fit test was carried out to learn whether the distribution of the aphasics' responses was at chance or not. As the p-values represented in **Figure 5** indicate, the null hypothesis that their performance on object focalisations is at chance cannot be ruled out for most patients. The only exceptions are, on the one hand, patient A1 who, as already pointed out, performed above chance on all conditions and, on the other hand, patient A4, whose performance on OSV focalisations was below chance, and patients A2 and A6, who performed below and above chance on OVS focalisations, respectively. On the other hand, all participants performed above chance on declaratives, as did 6 of the 7 participants on subject focalisations.
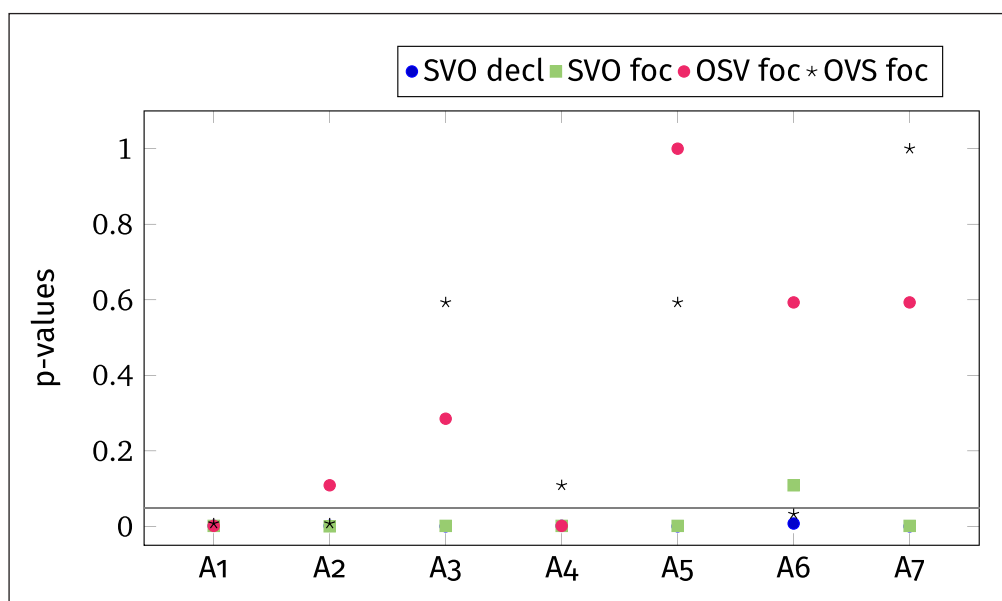

Figure 5: Aphasic individuals p-values by condition from the goodness of fit test (Experiment II).

4.3 Interim summary

We carried out a sentence-picture matching task to test the comprehension of contrastive focus in Catalan. The seven subjects with agrammatic aphasia that participated in the study showed a good performance of declaratives (12a) and subject topicalisations (12b), which is consistent with GM hypotheses. Their performance on object focalisations with preverbal (12c) and postverbal (12d) subjects, on the other hand, was poor. Like in the previous experiment, the object focalisation conditions involved greater intersubject variability, though most participants performed at or below chance on these sentences. Our findings call into question the GM hypothesis, as all the sentences included in the task involved mismatching of ϕ-feature between the subject and the object and, therefore, are predicted to be well-comprehended in agrammatic aphasia (11).

5 Discussion and conclusion

The goal of the present study was, on the one hand, to assess the comprehension of focalisation and clitic left dislocation in Catalan agrammatism and, on the other hand, to evaluate the Generalised Minimality hypothesis (Grillo 2009). In particular, we examined the prediction that a number mismatch between the subject and the object blocks generalised minimality effects and, hence, participants with Broca's aphasia are able to show good comprehension of the sentences.

5.1 The comprehension of SVO constructions

The results showed that the agrammatic subjects were able to comprehend declaratives, subject topicalisations and subject focalisations (**Tables 3** and **6**); that is, those sentences that display the superficial word order SVO to which thematic roles are assigned canonically. According to the logistic regression model, the results were verified at the individual level: on the one hand, all the participants performed above chance on declaratives in both experiments and, on the other hand, 7/9 and 6/7 subjects with aphasia showed an above-chance performance on subject topicalisations and focalisations, respectively. These findings are in line with previous research on the comprehension of active sentences with canonical word orders (among others, Burchert et al. 2003; Gavarró 2005; Friedmann et al. 2010; Jovanov 2011; Maviş et al. 2019). The results are also consistent with the GM hypothesis since these structures do not involve any potential intervener between the displaced constituent and its copy (14) and, therefore, minimality effects are avoided.

(14)   El policia$_i$, $<...>_i$ va mullar $<...>_i$ a les soldats$_j$ $<...>_j$
    $(\theta_1,\phi_{sg},{}^*)_A$ $(\theta_1,\phi_{sg},{}^*)_A$ $(\theta_2,\phi_{PL})_A$ $(\theta_2,\phi_{PL})_A$
    'The policeman, he wetted the soldiers.'

5.2 The comprehension of object clitics

The agrammatic participants also showed a good comprehension of object clitics (**Table 3**), as has been observed in previous literature (among others, Luzzatti et al. 2001; Baauw & Cuetos 2003; Martínez-Ferreiro 2010) and despite the superficial noncanonical word order of these structures (15). However, as already pointed out, most of these studies focused on the pronominal versus reflexive interpretation of clitics. In contrast, the focus of the present study was on the thematic interpretation by agrammatic aphasics, who succesfully pointed to the picture that displays the correct thematic interpretation both at the group and individual level, as most participants performed above chance on this condition (6/9 patients). The inclusion of tokens with clitics also allows us to rule out the possibility that the presence of the clitic is responsible for the poor comprehension on CLLDs. Both movement-derived and base-generated

accounts (see, among others, Suñer 1988) have been proposed in order to explain why clitic constructions present an atypical word order configuration. According to derivational analyses, clitics ultimately move as heads and adjoin the T head (Kayne 1989; Belletti 1999; and Solà 2002 for Catalan). Head movement (mainly verb movement) has been shown not to be problematic for agrammatic subjects (among others, Lonzi & Luzzatti 1993; Grodzinsky & Finkel 1998; Friedmann & Shapiro 2003; Bastiaanse & Edwards 2004), and it is predicted not be impaired within the GM framework (Grillo 2009). Further support for this conclusion comes from a study by Garraffa (2009), who carried out a grammaticality judgement task to evaluate the subject-verb agreement in Italian sentences with object clitics. One subject with nonfluent aphasia performed above chance on grammatical sentences with pre- and postverbal subjects, suggesting that the clitic did not intervene in these cases. Hence, our findings do not challenge the GM hypothesis under the analysis of clitics as an instance of head movement, since individuals with agrammatism are not hypothesised to have problems in comprehending these structures (15). The fact that significant differences between matched and mismatched sentences were only observed in the object clitic condition is orthogonal to the hypothesis, since no intervention configuration holds here (**Table 1**).

(15) El policia$_i$ les$_j$ va mullar $<...>_i$ $<...>_j$
      (θ_1, ϕ_{sg}) (θ_2, ϕ_{pl}) (θ_1, ϕ_{sg}) (θ_2, ϕ_{pl})
      'The policeman wetted them.'

An anonymous reviewer pointed out the possibility that subjects with aphasia may have been able to interpret sentences with object clitics by assigning an SV structure (or simply identifying the first DP as subject). Yet, if that was the case, we would have expected them to apply the same strategy with dislocations with preverbal subjects. Also, in a study conducted by Peristeri & Tsimpli (2013), Broca's aphasics correctly interpreted the gender and number of object clitics in Greek. These findings suggest that they interpret object clitics.

5.3 The comprehension of object contrastive focus and clitic left dislocation

The agrammatic interpretation of object dislocations and focalisations was compromised (**Tables 3** and **6**). This finding was verified at an individual level: 6 and 9 out of 9 subjects with aphasia showed a poor performance on CLLDs with preverbal and postverbal subjects, respectively, and 6 and 5 out of 7 participants performed poorly on object focalisations with preverbal and postverbal subjects (recall that, in our sample, one patient who had been classified as mild performed well on all item types). The presence of a resumptive clitic did not improve the comprehension of CLLD. The results on the comprehension of object focalisations are consistent with crosslinguistic previous research (among others, Burchert et al. 2003; Friedmann & Shapiro 2003; Gavarró 2005; Friedmann et al. 2010; Jovanov 2011).

Concerning the comprehension of CLLDs, the results reported in the present study differ from the only antecedent in Romance, Beretta et al. (2001), given that the nine Catalan-speaking aphasic individuals showed a higher percentage of correct responses in OSclV dislocations (67.8%) than the two Spanish-speaking (55%) who participated in Beretta et al. (2001). However, the sample of the latter study was smaller and very heterogeneneous: the two aphasic subjects' performances contrasted sharply as one participant reached a mean of 75% of correct responses, while the other one only produced 35% of correct responses.

In the present study, CLLDs with preverbal subjects were slightly better understood than their OVS counterparts, while object focalisations were comprehended at chance regardless of the position of the subject. In fact, the position of the subject was proven not to be relevant in Spanish actives and adjectival passives with preverbal and postverbal subjects in Beretta et al. (1996). It is possible that the three aphasic participants who understood OSclV above chance in the present study (**Figure 2**) assimilated them to clitic constructions. Several factors might have favoured this interpretation: on the one hand, the items tested contained an adverbial phrase to stress the contrastive feature of CLLD that stood between the dislocate and the matrix clause (*en canvi* 'in contrast'), and, on the other hand, the topic and the comment belonged to two different units prosodically differentiated to which aphasics are sensitive (Gavarró & Salmons 2013), hence highlighting the SclV configuration of the comment. If so, the participants may have parsed OSclV simply as SclV, and therefore reached the target interpretation.

Regarding the GM's predictions, the example in (16) reproduces the agrammatic representation of the matched CLLD tested in the present study: since the discourse-feature topic is underspecified, the topicalised element *al cocodril* 'the cocodrile' belongs to the argumental class and, such as, it is undistinguishable from the intervening subject *el mico* 'the monkey'. Therefore, our findings do not contradict the prediction that the aphasic comprehension of these sentences will be impaired:

(16)   a.   Al cocodril$_i$, el$_?$ va colpejar   el mico $<...>_?$
            $(\theta_?,\phi_{m.sg},^*)_A$ CL.M.SG $(\theta_1,\phi_{m.sg})_A$ $(\theta_2,\phi_{m.sg},^*)_A$
            'The cocodrile, the monkey hit him.'

        b.   Al cocodril$_i$, el mico   el$_?$ va colpejar $<...>_?$
            $(\theta_?,\phi_{m.sg},^*)_A$ $(\theta_1,\phi_{m.sg})_A$ CL.M.SG $(\theta_2,\phi_{m.sg},^*)_A$
            'The cocodrile, the monkey hit him.'

5.4 Number mismatch: a critical test to the GM hypothesis

The present study crucially contributes to testing the GM hypothesis by examining the representation of relevant morphosyntactic features that can prevent minimality effects, number in particular. Under the GM, the presence of intact mismatched number features is predicted to

suffice to link moved constituent to their copies, as they will block intervention effects in both object dislocations and focalisations with preverbal (17a) and postverbal (17b) subjects:

(17)   a.   A LES SOLDATS$_i$ el policia va mullar $<...>_i$
             $(\theta_?,\phi_{pl},*)_A$ $(\theta_1,\phi_{sg})_A$ $(\theta_2,\phi_{pl},*)_A$
             'THE SOLDIERS the policeman wetted.'

       b.   A les soldats$_i$, les$_i$ va mullar el policia $<...>_i$
             $(\theta_?,\phi_{pl},*)_A$ CL.PL $(\theta_1,\phi_{sg})_A$ $(\theta_2,\phi_{pl},*)_A$
             'The soldiers, the policeman wetted them.'

However, the results on object dislocations and focalisations in the present study (**Figure 3** and **Table 3**) did not improve when the subject and the object were mismatched in number. These findings bring the GM hypothesis into question. Still, Grillo (2008; 2009) could argue that the number feature does not suffice to avoid minimality effects, as the featural class that it introduces –argumental– is no different from the intervener's class. However, in a similar situation, the presence of the distinctive feature NP –which also introduces argumental class– is argued to account for the poor performance of aphasic individuals on object *which*-questions in contrast to object *who*-questions, which are well comprehended (Hickok & Avrutin 1996). This contrast in performance was explained in Grillo (2009:1436) because 'a perfect match between the impoverished moved object and the intervening subject obtains only with the *which*-NP type of question', and was later developed by Friedmann et al. (2009), who pointed out that the relevant property that sets *which*-questions (18a) apart from *who*-questions (18b) is the fact that the former contain a lexical NP, the same as the intervening subject.

(18)   a.   Which boy$_i$ did the girl kiss $<...>_i$?
             (WH, NP)$_Q$ (NP)$_A$ (WH, NP)$_Q$

       b.   Who$_i$ did the girl kiss $<...>_i$?
             (WH)$_Q$ (NP)$_A$ (WH)$_Q$

The presence of mismatched features is therefore predicted to block minimality effects in object focalisations (17a) and dislocations (17b) in Catalan. Our findings challenge this hypothesis, as agrammatics perform at chance in these conditions, in line with previous research (Adelt et al. 2017). These findings may suggest that the aphasics' representations are much more impoverished than argued by Grillo. The results in the present study do not suffice to rule out the hypothesis that the deficit observed in agrammatic aphasia is an instance of generalised minimality effects. The notion of intervention is relevant in linguistic theory in order to explain the formation and blocking of syntactic chains, and it has also been shown to be useful to explain the aphasics' poor performance in specific movement-derived sentences (Grodzinsky 2006; Grillo

2008; Friedmann & Gvion 2012), given that canonicity or movement alone do not suffice to account for the comprehension deficit (**Table 8**). What is called into question is the specific division of features proposed by Grillo.

Sentence type	Factors			Performance
	Canonicity	**Movement**	**Intervention**	
SVO decl	+	+	–	good
SVO topic	+	+	–	
SVO focus	+	+	–	
SoV clitic	–	+	–	
OSclV topic	–	+	+	poor
OSV focus	–	+	+	
OclVS topic	–	+	+	
OVS focus	–	+	+	

Table 8: Factors that interact with the structures tested and observed performance levels.

Finally, the presence of the colloquial accusative marker in both dislocations and focalisations did not suffice to interpret them, in line with what has been observed in the literature (see 2.2). These results are consistent with the GM hypothesis, since case is not predicted to block or give rise to minimality effects. But as already discussed in the introduction, few studies have claimed that case markers improve the comprehension of subjects with Broca's aphasia (Kljajevic & Murasugi 2010; Terzi & Nanousi 2018; Adelt et al. 2017; 2020). Case markers cannot be used as cues to comprehension because the assignment of thematic roles is not mediated by case markers. In fact, specific cases do not correspond to specific thematic roles (e.g. the subject in passives or unaccusatives receives the *theme* role) as they express the syntactic function and not the semantic interpretation of the constituent. Therefore, the putative sensitivity of Broca's aphasics to case marking would not entail a correct thematic assignment.

In the present study, variability among subjects was also observed, probably due to the heterogeneity of the aphasic group with regard to factors that have been shown to be relevant such as etiology, brain anatomy or lesion site (e.g. Geschwind 1970; Tomaiuolo et al. 1999; Amunts & Zilles 2006). Despite the variability, our findings reflected general patterns of response that have been previously observed in the aphasiology literature and that are replicated at an individual level. Interestingly, our results showed that problematic structures involved more heterogenous responses than well-comprehended sentences: between-subject variability increased on poorly understood constructions, which probably reflected the aphasics' problems in comprehension.

6 Conclusion

The results of the present study showed that the Catalan-speaking agrammatic subjects' comprehension of declaratives, subject topicalisations and subject focalisations, and sentences with object clitics was preserved; while the comprehension of object dislocations and object focalisations was impaired regardless of the position of the subject. These findings are, in that respect, consistent with the GM hypothesis (Grillo 2009), according to which the comprehension deficit in agrammatism can be explained as an instance of intervention effects. However, under Grillo's hypothesis, only discourse-scope features are hypothesised to be underspecified in Broca's aphasia, while morphosyntactic features merged at an earlier stage are predicted to be preserved. Here we examined whether the prediction that a mismatch of a criterial feature such as number in Catalan between the subject and the object blocks generalised minimality effects on object dislocations and focalisations. The agrammatic subjects' performance on mismatched sentences did not differ from their performance on sentences where subject and object were matched in number in the clitic left dislocation experiment; in the focalisation experiment, comprehension was impaired even though subject and object were mismatched in number and therefore predicted to be well understood. These findings call the hypothesis into question.

Abbreviations

Tables: Education: 1 = primary, 2 = secondary, 3 = higher. Lesion site: L = left, FT = frontotemporal, MCA = medial cerebral artery. Etiology: H = hemorrhagic, I = ischemic, CVA = cerebrovascular accident. TPO = time post onset. Severity: 1 = mild, 2 = moderate, 3 = severe.

Glosses: 3 = third person, ACC = accusative, AUX = auxiliary, CL = clitic, DET = determiner, F = feminine, FUT = future, GER = gerund, INF = infinitive, M = masculine, NEG = negation, PL = plural, PST = past, PRS = present, SG = singular

Data availability

The datasets analyzed for this study can be found in the UAB Deposit of Digital Documents (DDD): https://doi.org/10.5565/ddd.uab.cat/257484

Ethics and consent

The study was conducted according to the guidelines of the Helsinki Declaration (World Medical Association 2001) and approved by the Ethics Committee of the Universitat Autònoma de Barcelona (UAB CEEAH 5776) on Animal and Human Experimentation. All the subjects were asked to sign a written consent form prior to participation.

Acknowledgements

Special thanks to the aphasic and control participants, as well as the *Associació Sant Pau de Trastorns de la Comunicació*. Thanks are also due to Eduard Artés and Maria Fortuny for the recording of the materials, to Silvia Gannau for the drawings, and to the late Anna Espinal for the statistical analysis, and to two anonymous reviewers for their comments and suggestions. Any remaining errors are our own.

Competing interests

The authors have no competing interests to declare.

References

Abels, Klaus. 2007. Towards a restrictive theory of (remnant) movement. In van Craenenbroeck, Jeroen (ed.), *Linguistic variation yearbook*, 53–120. Amsterdam: John Benjamins Publishing. DOI: https://doi.org/10.1075/livy.7.04abe

Adani, Flavia. 2010. Rethinking the acquisition of relative clauses in Italian: towards a grammatically based account. *Journal of Child Language* 38(1). 141–165. DOI: https://doi.org/10.1017/S0305000909990250

Adelt, Anne & Burchert, Frank & Adani, Flavia & Stadie, Nicole. 2020. What matters in processing German object relative clauses in aphasia: timing or morphosyntactic cues? *Aphasiology* 34(8). 970–998. DOI: https://doi.org/10.1080/02687038.2019.1645290

Adelt, Anne & Stadie, Nicole & Lassotta, Romy & Adani, Flavia & Burchert, Frank. 2017. Feature dissimilarities in the processing of German relative clauses in aphasia. *Journal of Neurolinguistics* 44. 17–47. DOI: https://doi.org/10.1016/j.jneuroling.2017.01.002

Amunts, Katrin & Zilles, Karl. 2006. A multimodal analysis of structure and function in Broca's region. In Grodzinsky, Yosef & Amunts, Katrin (eds.), *Broca's region,* 17–30. New York: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780195177640.003.0002

Avrutin, Sergey. 2006. Weak syntax. In Grodzinsky, Yosef & Amunts, Katrin (eds.), *Broca's region*, 49–62. New York: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780195177640.003.0004

Baauw, Sergio & Cuetos, Fernando. 2003. The interpretation of pronouns in Spanish language acquisition and breakdown: evidence for the 'Principle B Delay' as a nonunitary phenomenon. *Language acquisition* 11(4). 219–275. DOI: https://doi.org/10.1207/s15327817la1104_2

Bastiaanse, Roelien & Edwards, Susan. 2004. Word order and finiteness in Dutch and English Broca's and Wernicke's aphasia. *Brain and Language* 89(1). 91–107. DOI: https://doi.org/10.1016/S0093-934X(03)00306-7

Belletti, Adriana. 1999. Italian/Romance clitics: structure and derivation. In van Riemsdijk, Henk (ed.), *Clitics in the languages of Europe*, 543–579. Berlin: Mouton de Gruyter. DOI: https://doi.org/10.1515/9783110804010.543

Belletti, Adriana. 2001. Inversion as focalization. In Hulk, Aafke C.J. & Pollock, Jean-Yves (eds.), *Subject inversion in Romance and the Theory of Universal Grammar*, 60–90. New York: Oxford University Press.

Belletti, Adriana & Friedmann, Naama & Brunato, Dominique & Rizzi, Luigi. 2012. Does gender make a difference? Comparing the effect of gender on children's comprehension of relative clauses in Hebrew and Italian. *Lingua* 122(10). 1053–1069. DOI: https://doi.org/10.1016/j.lingua.2012.02.007

Beretta, Alan & Harford, Carolyn & Patterson, Janet & Piñango, Maria. 1996. The derivation of postverbal subjects: evidence from agrammatic aphasia. *Natural Language and Linguistic Theory* 14. 725–748. DOI: https://doi.org/10.1007/BF00133362

Beretta, Alan & Schmitt, Cristina & Halliwell, John & Munn, Alan & Cuetos, Fernando & Kim, Sujung. 2001. The effects of scrambling on Spanish and Korean agrammatic interpretation: why linear models fail and structural models survive. *Brain and Language* 79. 407–425. DOI: https://doi.org/10.1006/brln.2001.2495

Bianchi, Valentina & Frascarelli, Mara. 2010. Is topic a root phenomenon? *Iberia: an international journal of theoretical linguistics* 2(1). 43–88.

Bonet, Eulàlia. 1990. Subjects in Catalan. *MIT Working papers in Linguistics* 13. 1–26.

Burchert, Frank & De Bleser, Ria & Sonntag, Katharina. 2003. Does morphology make the difference? Agrammatic sentence comprehension in German. *Brain and Language* 87(2). 323–342. DOI: https://doi.org/10.1016/S0093-934X(03)00132-9

Burchert, Frank & Swoboda-Moll, Maria & De Bleser, Ria. 2005a. The left periphery in agrammatic clausal representations: evidence from German. *Journal of Neurolinguistics* 18(1). 67–88. DOI: https://doi.org/10.1016/j.jneuroling.2004.11.007

Burchert, Frank & Weidlich, Christiane & De Bleser, Ria. 2005b. Focus in the left periphery: a cue to agrammatic sentence comprehension? *Brain and Language* 95(1). 115–116. DOI: https://doi.org/10.1016/j.bandl.2005.07.062

Burkhardt, Petra & Avrutin, Sergey & Piñango, Maria Mercedes & Ruigendijk, Esther. 2008. Slower-than-normal syntactic processing in agrammatic Broca's aphasia: evidece from Dutch. *Journal of Neurolinguistics* 21. 120–137. DOI: https://doi.org/10.1016/j.jneuroling.2006.10.004

Caramazza, Alfonso & Capitani, Erminio & Rey, Arnaud & Berndt, Rita S. 2001. Agrammatic Broca's aphasia is not associated with a single pattern of comprehension performance. *Brain and Language* 76(2). 158–184. DOI: https://doi.org/10.1006/brln.1999.2275

Caramazza, Alfonso & Zurif, Edgar B. 1976. Dissociation of algorithmic and heuristic processes in language comprehension: evidence from aphasia. *Brain and Language* 3(4). 572–582. DOI: https://doi.org/10.1016/0093-934X(76)90048-1

Cinque, Guglielmo. 1990. *Types of A'-dependencies*. Cambridge: The MIT Press.

Cinque, Guglielmo & Rizzi, Luigi. 2008. The cartography of syntactic structures. In Moscati, Vicenzo (ed.), *CISCL Working Papers on Language and Cognition*, vol. 2, 43–59. Università degli Studi di Siena.

Drai, Dan. 2006. Evaluating defici patterns of Broca's aphsics in the presence of high intersubject variability. In Grodzinsky, Yosef & Amunts, Katrin (eds.), *Broca's region*, 108–118. New York: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780195177640.003.0007

Drai, Dan & Grodzinsky, Yosef. 2006a. A new empirical angle on the variability debate: quantitative neurosyntactic analysis of a large data set from Broca's Aphasia. *Brain and Language* 96(96). 2. DOI: https://doi.org/10.1016/j.bandl.2004.10.016

Drai, Dan & Grodzinsky, Yosef. 2006b. The variability debate: more statistics, more linguistics. *Brain and Language* 96(2). 157–170. DOI: https://doi.org/10.1016/j.bandl.2005.05.004

Frazier, Lyn. 1998. Getting there (slowly). *Journal of Psycholinguistic Research* 27. 123–146. DOI: https://doi.org/10.1023/A:1023241830722

Friedmann, Naama. 2008. Traceless relatives: agrammatic comprehension of relative clauses with resumptive pronouns. *Journal of Neurolinguistics* 21(2). 128–149. DOI: https://doi.org/10.1016/j.jneuroling.2006.10.005

Friedmann, Naama & Belletti, Adriana & Rizzi, Luigi. 2009. Relativized relatives: types of intervention in the acquisition of A-bar dependencies. *Lingua* 119(1). 67–88. DOI: https://doi.org/10.1016/j.lingua.2008.09.002

Friedmann, Naama & Gvion, Aviah. 2012. Intervention an locality in agrammatic aphasia. In Bianchi, Valentina & Chesi, Cristiano (eds.), *Enjoy Linguistics! Papers offered to Luigi Rizzi on the occasion of his 60th birthday*, 192–204. CISCL Press.

Friedmann, Naama & Reznick, Julia & Dolinski-Nuger, Dina & Soboleva, Katya. 2010. Comprehension and production of movement-derived sentences by Russian speakers with

agrammatic aphasia. *Journal of Neurolinguistics* 23(1). 44–65. DOI: https://doi.org/10.1016/j.jneuroling.2009.08.002

Friedmann, Naama & Rizzi, Luigi & Belletti, Adriana. 2016. No case for case in locality: case does not help interpretation when intervention blocks A-bar chains. *Glossa: a journal of general linguistics* 2(1). 1–28. DOI: https://doi.org/10.5334/gjgl.165

Friedmann, Naama & Shapiro, Lewis P. 2003. Agrammatic comprehension of simple active sentences with moved constituents: Hebrew OSV and OVS structures. *Journal of Speech, Language, and Hearing Research* 46(2). 288–297. DOI: https://doi.org/10.1044/1092-4388(2003/023)

Garraffa, Maria. 2009. Minimal structures in aphasia: a study on agreement and movement in a non-fluent aphasic speaker. *Lingua* 119(10). 1444–1457. DOI: https://doi.org/10.1016/j.lingua.2008.04.004

Garraffa, Maria & Grillo, Nino. 2008. Canonicity effects as grammatical phenomena. *Journal of Neurolinguistics* 21(2). 177–197. DOI: https://doi.org/10.1016/j.jneuroling.2007.09.001

Gavarró, Anna. 2005. The interpretation of ambiguous dislocations in Broca's aphasia. *Brain and Language* 95(1). 117–118. DOI: https://doi.org/10.1016/j.bandl.2005.07.063

Gavarró, Anna. 2008. Binding and coreference in Catalan agrammatism. In *The Academy of Aphasia Meeting*. Turku.

Gavarró, Anna & Dotti, Horacio. 2014. Long and short passives in Catalan and Spanish. *Aphasiology* 28(1). 82–98. DOI: https://doi.org/10.1080/02687038.2013.843152

Gavarró, Anna & Salmons, Io. 2013. The discrimination of intonational contours in Broca's aphasia. *Clinical Linguistics and Phonetics* 27(8). 632–646. DOI: https://doi.org/10.3109/02699206.2013.800908

Geschwind, Norman. 1970. The organization of language and the brain. *Science* 170(3961). 940–944. DOI: https://doi.org/10.1126/science.170.3961.940

Grillo, Nino. 2008. *Generalized minimality: syntatic underspecification in Broca's aphasia*. Utrecht and Siena: Utrecht University and Università degli Studi di Siena dissertation.

Grillo, Nino. 2009. Generalized minimality: feature impoverishment and comprehension deficits in agrammatism. *Lingua* 119(11). 1426–1443. DOI: https://doi.org/10.1016/j.lingua.2008.04.003

Grodzinsky, Yosef. 2006. A blueprint for a brain map of syntax. In Grodzinsky, Yosef & Amunts, Katrin (eds.), *Broca's region*, 83–107. New York: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780195177640.001.0001

Grodzinsky, Yosef. 2010. The picture of the linguistic brain: how sharp can it be? Reply to Fedorenko and Kanwisher. *Language and Linguistics Compass* 4(8). 605–622. DOI: https://doi.org/10.1111/j.1749-818X.2010.00222.x

Grodzinsky, Yosef & Finkel, Lisa. 1998. The neurology of empty categories: aphasics' failure to detect ungrammaticality. *Journal of Cognitive Neuroscience* 20(2). 281–292. DOI: https://doi.org/10.1162/089892998562708

Grodzinsky, Yosef & Pieperhoff, Peter & Thompson, Cynthia. 2021. Stable brain loci for the processing of complex syntax: a review of the current neuroimaging evidence. *Cortex* 142. 252–271. DOI: https://doi.org/10.1016/j.cortex.2021.06.003

Grodzinsky, Yosef & Piñango, Maria & Zurif, Edgar B. & Drai, Dan. 1999. The critical role of group studies in neuropsychology: comprehension regularities in Broca's aphasia. *Brain and Language* 67(2). 134–147. DOI: https://doi.org/10.1006/brln.1999.2050

Hickok, Gregory & Avrutin, Sergey. 1996. Comprehension of wh-questions in two Broca's aphasics. *Brain and Language* 52. 314–327. DOI: https://doi.org/10.1006/brln.1996.0014

Institut d'Estudis Catalans. 2016. *Gramàtica de la llengua catalana [Catalan grammar]*. Barcelona: Institut d'Estudis Catalans. DOI: https://doi.org/10.2436/10.2500.04.1

Jovanov, Natasa. 2011. *A morpho-syntactic study of patients with Broca's aphasia: a comparative study of Serbian- and Greek-speaking patients*. Thessaloniki: Aristotle University of Thessaloniki dissertation.

Kayne, Richard S. 1989. Null subjects and clitic climbing. In Jaeggli, Osvaldo & Safir, Kenneth (eds.), *The Null Subject Parameter*, 239–261. Dordrecht: Kluwer. DOI: https://doi.org/10.1007/978-94-009-2540-3_8

Kertesz, Andrew & Pascual, Álvaro Pascual-Leone & García, Álvaro Pascual-Leone. 1990. *Batería de afasias Western: the Western Aphasia Battery en versión y adaptación castellana [Spanish version of Western Aphasia Battery]*. Valencia: Nau Llibres.

Kljajevic, Vanja & Murasugi, Kumiko. 2010. The role of morphology in the comprehension of wh-dependencies in Croatian aphasic speakers. *Aphasiology* 24(11). 1354–1376. DOI: https://doi.org/10.1080/02687030903515347

Lonzi, Lidia & Luzzatti, Claudio. 1993. Relevance of adverb distribution for the analysis of sentence representation in agrammatic patients. *Brain and Language* 45. 306–317. DOI: https://doi.org/10.1006/brln.1993.1048

López, Luis. 2009. *A derivational syntax for information structure*. Oxford: Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780199557400.001.0001

Luzzatti, Claudio & Toraldo, Alessio & Guasti, Maria Teresa & Ghirardi, Graziella & Lorenzi, Lorena & Guarnaschelli, Caterina. 2001. Comprehension of reversible active and passive sentences in agrammatism. *Aphasiology* 15(5). 419–441. DOI: https://doi.org/10.1080/02687040143000005

Martínez-Ferreiro, Silvia. 2010. *Towards a characterization of agrammatism in Ibero-Romance*. Barcelona: Universitat Autònoma de Barcelona dissertation.

Martini, Karen & Belletti, Adriana & Centorrino, Santi & Garraffa, Maria. 2020. Syntactic complexity in the presence of an intervener: the case of an Italian speaker with anomia. *Aphasiology* 34(8). 1016–1042. DOI: https://doi.org/10.1080/02687038.2019.1686744

Maviş, İlknur & Arslan, Seçkin & Aydin, Özgür. 2019. Comprehension of word order in Turkish aphasia. *Aphasiology* 0. 1–17. DOI: https://doi.org/10.1080/02687038.2019.1622646

Nanousi, Vicky & Terzi, Arhonto. 2017. Noncanonical sentences in agrammatism: the case of Greek passives. In Georgakopoulos, Thanasis & Pavlidou, Theodossia-Soula & Pechlivanos, Miltos & Alexiadou, Artemis & Androutsopoulos, Jannis & Kalokairinos, Alexis & Skopeteas, Stavros & Stathi, Katerina (eds.), *Proceedings of the 12th International Conference in Greek Linguistics*, vol. 2. 141–156. Berlin: Edition Romiosini.

Ordóñez, Francisco. 2007. Cartography of postverbal subjects in Spanish and Catalan. In Baauw, Sergio & Drijkoningen, Frank & Pinto, Manuela (eds.), *Romance Languages and Linguistic Theory 2005*, 259–280. Amsterdam: John Benjamins Publishing. DOI: https://doi.org/10.1075/cilt.291.17ord

Ott, Dennis. 2014. An ellipsis approach to contrastive left-dislocation. *Linguistic Inquiry* 45(2). 269–303. DOI: https://doi.org/10.1162/LING_a_00155

Peristeri, E. & Tsimpli, I. M. 2013. Pronoun processing in Broca's aphasia: discoursesyntax effects in ambiguous anaphora resolution. *Aphasiology* 27(11). 1381–1407. DOI: https://doi.org/10.1080/02687038.2013.828344

Prieto, Pilar. 2002. *Entonació. Models, teoria, mètodes*. Ariel Lingüística.

Raithel, V. 2005. *The perception of intonation contours and focus by aphasic and healthy individuals*. Gunter Narr Verlag.

Rivero, María Luisa. 1980. On left-dislocation and topicalization in Spanish. *Linguistic Inquiry* 11(2). 363–393.

Rizzi, Luigi. 1982. *Issues in Italian syntax*. Dordrecht: Foris Publications. DOI: https://doi.org/10.1515/9783110883718

Rizzi, Luigi. 1990. *Relativized Minimality*. Cambridge: The MIT Press.

Rizzi, Luigi. 2004. Locality and left periphery. In Belletti, Adriana (ed.), *Structures and beyond: the cartography of syntactic structures*, vol. 3, 104–131. Oxford: Oxford University Press.

Rubio, Carlos. 2014. *Syntactic constraints on topicalization phenomena*. Barcelona: Universitat Autònoma de Barcelona dissertation.

Salmons, Io. 2015. *The agrammatic comprehension of contrastive focus and clitic left dislocation in Catalan*. Bellaterra: Universitat Autònoma de Barcelona dissertation.

Sancho, Pelegrí. 2002. La preposició i el sintagma preposicional [The preposition and the prepositional phrase]. In Solà, Joan & Lloret, Maria Rosa & Mascaró, Joan & Saldanya, Manuel Pérez (eds.), *Gramàtica del català contemporani [Grammar of Contemporary Catalan]*, vol. 2: Sintaxi (1–16), 1689–1796. Barcelona: Empúries.

Santi, Andrea & Grodzinsky, Yosef. 2007. Working memory and syntax interact in Broca's area. *NeuroImage* 37(1). 8–17. DOI: https://doi.org/10.1016/j.neuroimage.2007.04.047

Santi, Andrea & Grodzinsky, Yosef. 2010. fMRI adaptation dissociates syntactic complexity dimensions. *NeuroImage* 51(4). 1285–1293. DOI: https://doi.org/10.1016/j.neuroimage.2010.03.034

Santi, Andrea & Grodzinsky, Yosef. 2012. Broca's area and sentence comprehension: a relationship parasitic on dependency, displacement or predictability? *Neuropsychologia* 50(5). 821–832. DOI: https://doi.org/10.1016/j.neuropsychologia.2012.01.017

Sheppard, Shannon & Walenski, Matthew & Love, Tracy & Shapiro, Lewis P. 2015. The auditory comprehension of wh-questions in aphasia: support for the intervener hypothesis. *Journal of Speech, Language, and Hearing Research* 58. 781–797. DOI: https://doi.org/10.1044/2015_JSLHR-L-14-0099

Solà, Jaume. 1992. *Agreement and subjects*. Bellaterra: Universitat Autònoma de Barcelona dissertation.

Solà, Jaume. 2002. Clitic climbing and null subject languages. *Catalan Journal of Linguistics* 1. 225–255. DOI: https://doi.org/10.5565/rev/catjl.60

Solà, Joan. 1994. *Sintaxi normativa: estat de la qüestió [Normative syntax: the state of the question]*. Barcelona: Editorial Empúries.

Suñer, Margarita. 1988. The role of agreement in clitic-doubled constructions. *Natural Language and Linguistic Theory* 6(3). 391–434. DOI: https://doi.org/10.1007/BF00133904

Suñer, Margarita. 2003. The lexical preverbal subject in a Romance null subject language: where are thou? In *A Romance perspective on language knowledge and use*, 341–357. Amsterdam: John Benjamins Publishing. DOI: https://doi.org/10.1075/cilt.238.25sun

Terzi, Arhonto & Nanousi, Vicky. 2018. Intervention effects in the relative clauses of agrammatics: the role of gender and case. *Glossa: a journal of general linguistics* 3(1). 1–23. DOI: https://doi.org/10.5334/gjgl.274

Tomaiuolo, Francesco & MacDonald, Jonathan & Caramanos, Zografos & Posner, Glenn & Chiavaras, Mary & Evans, A.C. & Petrides, Michael. 1999. Morphology, morphometry and probability mapping of the pars opercularis of the inferior frontal gyrus: an in vivo MRI analysis. *The European Journal of Neuroscience* 11(9). 3033–3046. DOI: https://doi.org/10.1046/j.1460-9568.1999.00718.x

Vallduví, Enric. 1993. Catalan as OVS: evidence from information packaging. In Ashby, William J. & Mithun, Marianne & Perissinotto, Giorgio (eds.), *Linguistic Perspectives on Romance Languages: selected papers from the XXI Linguistic Symposium on Romance Languages*, 335–350. Amsterdam: John Benjamins Publishing. DOI: https://doi.org/10.1075/cilt.103.31val

Varlokosta, Spyridoula & Nerantzini, Michaela & Papadopoulou, Despina & Bastiaanse, Roelien & Beretta, Alan. 2014. Minimality effects in agrammatic comprehension: the role of lexical restriction and feature impoverishment. *Lingua* 148. 80–94. DOI: https://doi.org/10.1016/j.lingua.2014.05.013

Vasic, Nada & Avrutin, Sergey & Ruigendijk, Esther. 2006. Interpretation of pronouns in VP-ellipsis constructions in Dutch Broca's and Wernicke's aphasia. *Brain and Language* 96(2). 191–206. DOI: https://doi.org/10.1016/j.bandl.2005.04.003

Villa-García, Julio. 2013. On the status of preverbal subjects in Spanish: evidence for a dedicated subject position. In Keine, Stefan & Sloggett, Shayne (eds.), *NELS 42*, 245–246. Amherst: Graduate Linguistic Student Association of the University of Massachusetts.

Villalba, Xavier. 2009. *The syntax and semantics of dislocations in Catalan*. Köln: Lambert Academic Publishing.

World Medical Association. 2001. World medical association declaration of helsinki. ethical principles for medical research involving human subjects. *Bulletin of the World Health Organization* 79(4). 373–374.