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Minimal structures in aphasia: A study on agreement and movement in a non-fluent aphasic speaker

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Abstract

To investigate the linguistic competence of a non-fluent aphasic speaker we focus on certain properties of the patient's deficit in the functional lexicon, and ascribe occurrences of non-standard use to defective syntactic computation. By manipulating the position of constituents, we tested agreement in sentences with post-verbal subjects and the patient's ability to detect errors induced by different elements in attraction configurations.

The results show clear asymmetries in grammaticality judgments of the different agreement conditions. A deficit in the computation of agreement in sentences with post-verbal subjects was reported, indicating the fragile nature of post-verbal subject agreement. In the experiment on attraction we found a clear impairment, with attraction induced by linear intervention of a prepositional modifier. However, the patient does not regard clitics as potential interveners in the SubjV agreement relation, in accordance with the view that there is no evidence for the weak status of clitic pronouns in Italian.

By investigating the finer properties of functional elements we hope to show the extent to which certain characteristics of aphasic speech may be attributed to a possible reduction in the ability to process the finer structures of linguistic computations. A deficit in non-local configurations (the establishment of a relation over an intervening argument), along the lines of recent theoretical developments, was attested.

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1. Introduction

The present research is a neurolinguistic investigation of various Subject–Verb (SubjV) agreement configurations in a non-fluent Italian aphasic speaker. Subject–Verb agreement was investigated in an experiment in which the positions of sentence constituents – pre-verbal and post-verbal subjects – were manipulated. Evidence from comparative syntax and language acquisition reveals differences in the realization of agreement morphology depending on whether the subject is pre-verbal, hence in a *local* Spec/head configuration, or post-verbal, i.e. in a *non-local* environment. We also tested the ability of our subject to judge agreement errors in attraction configurations, where various elements intervene between the subject and the verb. In light of previous research on French adult

speakers (Frank et al., 2006) we focused on number mismatches within the VP by testing attraction induced by different attractors: prepositional modifiers and object clitics.

We chose an agrammatic Broca's aphasic because much work on agrammatic aphasia focuses on functional elements and the tendency to drop these items is characteristic of this type of speech (see Menn and Obler, 1990 for a cross-linguistic overview). In the present research we focus on various elements covered by the global term 'functional lexicon' by testing *fluctuations* in the grammatical system, an area of constrained variation where the occurrence of an element in the syntactic structure is consistent with its configurational environment. This issue is closely linked to the general anti-optional character of human language and its consequences in terms of hierarchical restriction and parametric selection. Fine distinctions related to the possibility of dropping material depending on the grammatical context are critical in syntactic derivation (see, for example, Rizzi, 2005 on the possibility of dropping pronouns in a restricted structural environment in acquisition; Hamann et al., 2003 for a study on complement pronouns in children with Specific Language Impairment; Friedmann, 2002 for the production of interrogatives in aphasia related to different structural layers).

The goal of the research is twofold. On the one hand we are interested in certain properties of the patient's deficit, and ascribe occurrences of non-standard use of agreement to defective syntactic computation. On the other hand, we want to strengthen the theoretical model on language with data from neurolinguistics which support linguistic distinctions such as the varying nature of pronominal clitics in Romance languages.

2. On subject agreement

Implementation of Subject–Verb agreement is related to subject position. An interesting property of post-verbal order (VSubj) is the way in which agreement morphology is differently realized cross-linguistically (see Guasti and Rizzi, 2002 and quoted literature).

English realizes morphological agreement, as in (1a); in French the pre-verbal subject agrees with the verb (1b), whereas the post-verbal subject does not (1c). In this paradigm standard Italian patterns with English—compare (1a) and (1d).

(1) a.   There come three girls
     b.   Trois filles sont arrivées
          Three girls have arrived
     c.   Il est arrivé trois filles
          It has arrived three girls
          Three girls have arrived
     d.   Sono arrivate tre ragazze
          They-are arrived three girls
          Three girls have arrived

These observations are consistent with the proposal that realization of agreement is related to the positional properties of the elements concerned and support a grammatical interpretation of the phenomenon. In post-verbal configurations morphological realization of number agreement is not mandatory. Agreement between the inflected verb and the inverted subject is never richer than agreement between Agr° and SpecAgrP.

According to the view that agreement processes are the reflex of an established Spec–head relation inside an Agr projection, as revealed by (pre-verbal) subject agreement, post-verbal subject agreement involves checking in a non-local configuration and the building of a syntactic chain. In their paper they argue that agreement in SubjV structures is checked twice: AgrS gets valued through AGREE and its features are then checked after movement of the subject, in a local Spec–head configuration. In VSubj structures agreement is established uniquely under AGREE, as agreement checking in the local Spec–head configuration is not available. The formalism expressed in (2) presents Agreement as a grammatical process related to hierarchical factors.

(2) a.   DP ... AGR syntactic checking
     b.   AGR ... DP specific property of the system   (Guasti and Rizzi, 2002)

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From this perspective, the post-verbal subject seems to be a clear case of fluctuation; whereas the expression of agreement is related to syntactic checking in the pre-verbal domain (a Spec/head relation in a specific AgrP phrase), in VSubj order it is governed by non-syntactic factors (variations in individual grammars). The interplay between active subject positions, whether pre-verbal (SubjV) or post-verbal (VSubj), and the morphological realization of agreement is subject to constrained variation and offers us a precise domain in which to evaluate performance on grammatical distinctions. More generally, it is cross-linguistically attested that agreement within a Spec/head is never poorer than agreement across a greater distance in the clause. We will see that this effect is visible at a processing level and that in configurations such as (2b) the system is more prone to error: agreement has variable morphological expression. Neurolinguistic investigation of these non-fixed domains is an interesting issue since it offers us a method for investigating grammatical variation across languages.

2.1. On subject agreement in attraction configurations

The next step is to test SubjV agreement in different configurations in order to throw light on distinct effects in agreement computations. A productive empirical stratagem for studying different agreement configurations at the sentence level is the phenomenon of attraction. Attraction is manifested when an element intervening between two elements sharing an agreement relation, and mismatched in the relevant agreement features, attracts agreement. This can be simplified in the abstract configuration in (3a), producing an effect as in (3c).

(3)   X   …   Z   …   Y
(3a) […, $\varphi_{Singular}$]   […,φ_{Plural}][…,$\varphi_{Singular}$]
(3b) The boat of the American **soldiers**   leaves   in the fog
(3c)*The boat of the American **soldiers   leave**   in the fog

Much experimental work has shown that there is a proximity concord effect determined by the closest noun to the verb in elicited production of sentences such as (3) (Bock and Miller, 1991). All these ''attraction effects'' are related to *locality conditions*. An intervening element with certain characteristics disrupts a local relation, in this case concordance.

We presume that the processor, having to proceed under time pressure and with strong working memory constraints, wants a clear indication of the nature of the elements to link in a local relation. When linear and hierarchical orders conflict, the system is prone to error.

By looking at attraction effects in impaired grammars we can broaden the scope of our investigations to throw light on these grammatical distinctions than might be possible in research confined to unimpaired grammars.
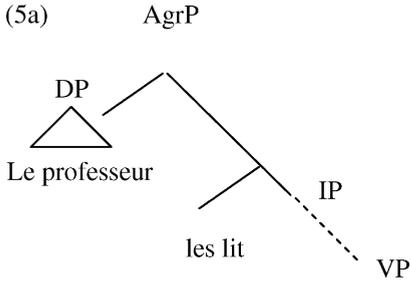
A recent study on the structural properties of number features within the VP (Frank et al., 2006) shows different effects in production with different syntactic relations: linear precedence vs. hierarchical order. Frank et al. investigated attraction effects with two different classes of interveners in French: prepositional modifiers and clitic object pronouns.

(4a) Le professeur les   lit/*lisent
      The professor them reads/read
(4b) Le professeur des élèves   lit/*lisent
      The professor of the students reads/*read   (examples from Franck et al.2006 [18].)
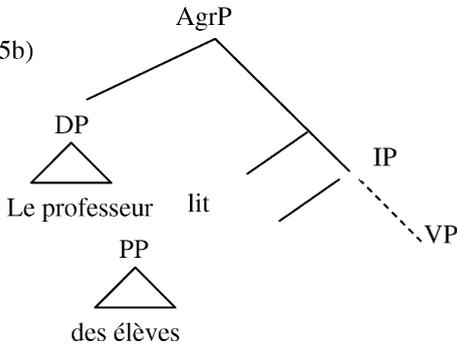
In the experiments with French speakers a larger number of attraction errors were found with clitics than with prepositional modifiers. This effect was attributed to differences in the structural relations involved. In (4a) the intervening constituent, the clitic, is in a c-command relationship with the agreement head while in (4b) the intervening element is merely in a configuration of linear precedence,[1] as can be seen in (5a) and (5b).

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[1] Plural intervening elements were also found to generate more errors than singulars. This effect is attested in other studies suggesting that plural nouns are marked forms and are therefore more disruptive interveners.

(5a)   AgrP

      DP

    Le professeur

              IP

        les lit

               VP

         AgrP

(5b)

     DP

   Le professeur   lit

             IP

      PP

             VP

    des élèves

We looked the two different structural configurations in which an intervening element has the potential to trigger an attraction effect.

(6a) $[_{Subj}\ldots N_{head}\ldots N_{mod}\ldots]$ AgrS
       Il professore degli studenti legge
       The professor of the students reads

(6b)   AgrS $[_{Subj}\ldots N_{head}\ldots N_{mod}\ldots]$
       Legge il professore degli studenti
       Reads the professor of the students
       The professor of the students reads

As can be seen in (6a), the prepositional modifier intervenes between the head noun and AgrS. This is not the case in (6b) where we assume the presence of a rich VP periphery and activation of a possible low focal position for the post-verbal subject (see Belletti, 1990, 2004 and related works) with no stage of agreement verification in a Spec/head relation in AgrSP or movement of the verb to AgrS for inflectional requirements.

We investigated attraction effects in (6a) compared with the unraised post-verbal subject in (6b). Examination of the subject's finer positional distinctions is beyond the scope of this article.

The second condition is intervention by an object clitic, a pronominal element with specific configuration properties.

(7a) $[_{Subj}\ldots N_{head}\ldots] [_{AgrOP}$ AgrO $_{clitic}$ AgrS $[_{VP} t_s\, t_v\, t_o]]$
      Il professore   le   legge
      The professor   them reads
      The professor reads them

(7b) $[_{AgrOP}$ AgrO $_{clitic}$ AgrS $[_{VP} N_{Subj}\ldots t_v\, t_o]$
        Le   legge il professore
        Them   reads the professor
     The professor reads them

In the derivation of (7) the clitic has to incorporate with the verb to establish a local relation. We are interested in the possible distinctions between (7a) and (7b) in term of attraction and to the theoretical implications of this kind of facts.

3. Notes on non-fluent Broca's aphasia

Characterization of agrammatic Broca's aphasia directly involves the formulation of a specific algorithm related to the computation of syntactic structures. Since Caramazza and Zurif's work (1976), impairment in assigning the correct thematic role in the comprehension of sentences with non-canonical word order, such as passives, object relatives and object clefts, while comprehension of actives, subject relatives and subject clefts is preserved, has been robustly attested. In Caramazza and Zurif's study the aberrant performance on sentences with non-canonical word order was defined as *asyntactic comprehension* and the deficit was related to restricted access to syntactic-like algorithm processes which are damaged in Broca's aphasics.

Agrammatic Broca's aphasia is also characterized by non-fluent speech; speech output reveals a tendency to drop functional elements such as determiners, complementizers, and auxiliaries. In the present investigation we aim to establish a correlation between the deficit with functional words and the impairment in comprehension of non-canonical sentences; to this end we investigated *locality conditions* as configurational restrictions on syntactic computations and functional elements as fundamental triggers for computational processes.

Functional categories trigger fundamental linguistic computations, such as movement, stepwise from subordinate to super-ordinate categories in the tree structures.

Impairment in the functional lexicon should therefore lower the likelihood of these computations succeeding.[2]

In the literature on non-fluent aphasic speech, it has been suggested that not all the functional lexicon is necessarily damaged, indicating that distinctions may be made within this category. Friedmann and Grodzinsky (2000) found that in the patients they studied omission of items from the functional lexicon is sensitive to the position of these elements in the syntactic tree. Cross-linguistic observations show selective omission in the production of temporal morphology yet preserved number features in subject–verb agreement; this led Friedmann to hypothesize a structural reduction of the syntactic tree (*The Tree Pruning Hypothesis*; Friedmann, 2002). Further important evidence comes from a study on SubjV agreement in five German Broca's aphasics (Janssen and Penke, 2002). In this study agreement errors consisted in the substitution of marked features by an unmarked form. They concluded that inflectional affixes seem to be organized in the mental lexicon according to the specification of their morphosyntactic value in an underspecified paradigm.

The existence of a distinction between an accessible projection in the tree (Subject agreement, AgrP) and more inaccessible positions (Tense phrase, TP) appears to be borne out by agrammatic production data. Such data provide a strong argument in favor of morphological features not being projected from overt morphology but instead being related to morphosyntactic variation (Pollock, 1989). Discussion of tense and agreement in non-fluent aphasia has focused almost exclusively on production. In principle, there is no reason why similar phenomena should not be investigated in other linguistic modalities. Assuming that grammatical selections are parsing strategies, the impairment in verbal morphology witnessed in Broca's aphasics could be explained in terms of computational preferences. In this sense, interesting evidence comes from a recent study on processing in adult speakers (De Vincenzi, 1991; De Vincenzi et al., 2006). Reading times and event related potentials (ERPs) were collected in order to investigate responses to number violations and tense violations on verbs. The ERPs showed number agreement violations appearing in an early phase while violations of temporal morphology were detected in a later temporal window: number violations elicited a left anterior negativity (LAN) 60 ms earlier than the LAN elicited by violations of Tense concordance.

Thus there is converging evidence (from reading times, electrophysiological and neuropsychological data) supporting distinct processing of the two morphosyntactic relations, number subject–verb agreement and temporal adverb–verb concordance. Data from patients with cerebral lesions concur with the evidence from normal adult subjects. The evidence appears to be consistent with two possible interpretations regarding the grammatical impairment: a purely *knowledge based* approach related to positional variables such as that advanced in Friedmann's

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[2] The plausibility of the functional lexicon forming a natural class, distinct from the contentive lexicon, is seen in much evidence stemming from language acquisition, language use and pathology (see Rizzi, 2004 for an overview of some aspects of the functional lexicon in relation to syntactic computations).

Structural Tree Pruning Hypothesis, or a more integrated approach in which grammatical distinctions are processing aids to parsing sentences (Garraffa, 2007; Garraffa and Grillo, 2008).

In the present study we analyze SubjV agreement in greater depth in order to address the structural aspects of the underspecified paradigm; that is, a preference for unmarked forms as well as the possible relationship with syntactic operations.

4. Methods

4.1. The participant

We present here a single case study of a non-fluent aphasic patient. M.R. is a 42-year-old, right handed, Italian woman. She has aphasia caused by a focal lesion in the frontal and parietal areas of the left hemisphere caused by a stroke in the zone of the medial cerebral artery (MCA). The unilateral damage was ascertained by CT-scan.

After the lesion event the patient showed global aphasia and right hemiparesis. Her linguistic competence subsequently improved until she reached a stage of non-fluent elliptical speech.

This study was conducted 2 years post-onset by which time M.R.'s condition had stabilized. Language screening was carried out with the standard battery for Italian speakers (B.A.D.A.—Batteria Analisi Deficit Afasico) (Miceli et al., 1994). The most typical features which the screening revealed were: difficulties with object and action naming (43.3% of objects were correct, 57.1% of actions), non-fluent speech with omission of grammatical elements (such as determiners and clitics), substitution of verbal inflection (infinitival forms in finite contexts and tense substitutions), impairment in comprehension of reversible sentences with inversion of thematic roles, failure in grammaticality judgments of object relative clauses and of pronoun reference, low scores in working memory tasks measured at the word list level.

Reading and writing abilities were also greatly impaired, but they are not dealt with in this study.

4.1.1. The repertoire of M.R.'s spontaneous speech

We collected spontaneous speech for a period of 4 months and compiled a corpus of 132 narrative sentences. Analysis of lexical verbs (60 out of a total of 84 verbs) in M.R.'s spontaneous production shows a high percentage of substitution of Tense morphology (21/60) but few errors in subject–verb agreement (3/60). It is, moreover, interesting to note that the few agreement substitutions attested in production occur with post-verbal subjects. Since data from spontaneous speech are quite variable (even if they are the most direct expression of linguistic competence) we ran a sentence completion task. In this task the subject had to complete a sentence with the correct verb form. The target response was either a form inflected for tense, as in (8a), or a form inflected for number, as in (8b) (based on Friedmann, 1998).

(8a)   Today the girl paints the room. Yesterday the girl_____.
(8b)   Today the girl paints the room. Today they_____.

M.R. confirmed the tendency shown in her spontaneous production: many errors with temporal morphology (23/36) and few with agreement morphology (2/36). We ran a test to study specifically the occurrence of subject inversion in M.R.'s production.[3] In the elicitation task we manipulated verb classes since a preference for VSubj order with unaccusative verbs compared with unergatives and transitives is attested in the literature (see Lorusso et al., 2005). M.R.'s responses were sensitive to verb type and she produced more VSubj orders with unaccusative verbs (18/24) than with unergatives (5/16). This provided evidence that M.R. is able to manage inversion and so we were able to rule out a general deficit in VSubj order per se.

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[3] The task adopted was originally elaborated to test L2 acquisition of specific properties of Italian grammar, such as the possibility of placing a subject post-verbally (see Garraffa, 2007 for details) and consisted in the elicitation of answers to questions whose pragmatic contexts require a response with a post-verbal subject, such as in an 'out of the blue' context:

i.   Chi è arrivato?
     Who is arrived?
ii. E' arrivato Gianni. ('Gianni è arrivato' it is not appropriate in this context)
      Is arrived Gianni.

4.2. Materials and procedure for the grammaticality judgment task

The experiment consisted of a series of auditory grammaticality judgment tasks. M.R had to judge the grammaticality of a battery of sentences, composed of three different sets of propositions. Half the items were grammatical and half were ungrammatical.

The first set involved agreement in SubjV and VSubj configurations, such as (9) and (10).

(9a)   La nave parte/*partono
        The boat leaves/*leave
(9b)   Le navi partono/*parte
        The boats leave/leaves

(10a)   Parte/*partono la nave
        Leaves/*leave the boat
(10b)   Partono/*Parte le navi
        Leave/*Leaves the boats

A total of 128 items were presented, 32 in each of the four conditions (SubjV, *SubjV, VSubj, *VSubj).

The second set consisted of a list of sentences containing intervening prepositional modifiers and either pre- or post-verbal subjects, such as in (11) and (12). Two types of effect were tested with these sentences: attraction by an intervening prepositional modifier and the predicted absence of attraction in sentences with post-verbal subjects due to non-linear intervention.

[Subj–PP–VP]
(11a)   L'autista dei ministri guida/*guidano con prudenza
        The driver of the ministers drives/*drive with caution
(11b)   Gli autisti del ministro guidano/*guida con prudenza
        The drivers of the minister drive/*drives with caution

[VP–Subj–PP]
(12a)   Guida/*guidano con prudenza l'autista dei ministry
        Drives/drive with caution the driver of the ministers
(12b)   Guidano/*guida con prudenza gli autisti del ministro
        Drive/drives with caution the drivers of the minister

This set consisted of 40 items in each of the four conditions (SubjPPV, *SubjPPV, VSubjPP, *VSubjPP), total 160 items.

The third set was composed of sentences with complement clitic interveners. In this test we investigated the intervention of an element in a local structural relation and non-linear intervention in VSubj sentences, such as in (13) and (14) respectively.

[Subj–Clitic–VP]
(13a)   Il corridore li supera /*superano
        The runner them overtakes /*overtake
(13b)   I corridori lo superano/*supera
        The runners him overtake/*overtakes

[Clitic–VP–Subj]
(14a)   Li supera/*superano il corridore
        Them overtakes/*overtake the runner
(14b)   Lo superano/*supera I corridori
        him overtake/*overtakes the runners

Table 1
Experimental conditions and number of items per condition

Inversion	Gram	VS	PP	Clitic	Total
+	+	32	40	40	112
−	−	32	40	40	112
−	+	32	40	40	112
+	−	32	40	40	112
		128	160	160	448

A total of 160 items were presented, 40 in each of the four conditions (SubjcliV, *SubjcliV, cliVSubj, *cliVSubj). All the verbs selected are optionally transitive in Italian (for example, *guidare* 'to drive', *superare* 'to overtake'). Only direct object complement clitics were tested; indirect objects were not included in the list. A summary of the various conditions and the number of items per condition is presented in Table 1.

Inversion refers to those items with a subject in post-verbal position. Grammaticality refers to the well-formedness of the sentences. VSubj/PP/Clitic are the three variables investigated, respectively the baseline with no intervention, intervention of a prepositional modifier and intervention of a clitic. All conditions were balanced in number mismatches (half the items were Singular/Plural and half were Plural/Singular).

As filler items we selected two different sentence types. For the clitic condition we used sentences with reflexive pronouns, as in (15a). For the prepositional modifier condition we used items with either the same number feature or uninflected words, such as in (15b).

(15a)   Le verdure fresche **si** vendono al mattino
        The vegetables fresh **refl.** sell in the morning
(15b)   Il maglione **di lana** scalda
        The sweater of wool keeps-warm

The experiment with M.R. was run over ten sessions. In each session a proportional number of experimental sentence types was presented in randomized order.

A control baseline was run in order to test the two attraction conditions without agreement mismatches:

Singular–Singular [SS] and Plural–Plural [PP], as in (16) and (17).
(16a)   Il cane del ragazzo morde/*mordono
        The dog of the boy bites/*bite
(16b)   I cani dei ragazzi mordono/*morde
        The dogs of the boys bite/*bites

(17a)   Le scimmie li saltano/*salta
        The monkeys them jump-over /*jumps-over
(17b)   La scimmia lo salta/*saltano
        The monkey him jumps-over/*jump-over

M.R. showed little difficulty with the control experiment. She performed the tasks in the SS and PP conditions without a significant number of errors (2/40). This is important as it shows that a general difficulty in judging ungrammatical items can be excluded as a potential bias factor.

5. Results

In this section we report the results of the grammaticality judgment tasks separately for the three conditions: agreement in SubjV vs. VSubj structures, attraction with a prepositional modifier and attraction with an object clitic.

The unimpaired control participants, matched for age and education, performed at ceiling in all conditions.

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Table 2
MR's performance on SV–VS grammatical judgments

	Inversion	Gram	Errors	%	Sentences
SV	–	+	0/32	0	La nave parte/Le navi partono The boat leaves/The boats leave
*SV	–	–	2/32	6.2	*Le navi parte/ *La nave partono *The boats leaves/*The boat leave
VS	+	+	0/32	0	Parte la nave/Partono le navi Leaves the boat/Leave the boats
*VS	+	–	10/32	31.2	*Parte le navi/* Partono la nave *Leaves the boats/*Leave the boat
	Total		12/128	9.3	

5.1. Experiment on agreement in VSubj and SubjV sentences

In the first experiment M.R. performed well with only 12/128 errors (9.3%). The task is simple to perform since it involves judging the grammaticality of three-word sentences (Table 2).

The majority of errors were found with sentences featuring ungrammatical post-verbal subjects (*VSubj) (10/32; 31.2%). Performance differed significantly from chance level in this condition (z-score(1) = 2.12, $p < .025$) and also differed significantly from the grammatical VSubj condition ($\chi^2(1) = 9.6$, $p < 0.05$). The difference between the two ungrammatical conditions, *SubjV and *VSubj, was also significant ($\chi^2(1) = 5$, $p < 0.05$).

5.2. Experiment on intervention with prepositional modifiers

The second experiment tested accuracy of judgment of subject–verb agreement with an intervening prepositional modifier. M.R.'s responses show attraction effects with grammatical SPPV items, 10/40 errors (25%) with performance above chance level (z-score(1) = 3.16, $p < .005$) (Table 3).

With respect to subject–verb inversion, performance in the grammatical condition, VSubjP, was above chance level with 6/40 (15%) errors (z-score(1) = 4.42, $p < .005$). There were significant differences between the two inverted conditions, VSubjPP and *VSubjPP, ($\chi^2(1) = 20.6319$, $p < 0.05$). In the ungrammatical inverted condition, *VSubjP, a high error rate of 27/40 (67.5%) (z-score(1) = 2.21, $p < . 025$) was found, with performance below chance level.

5.3. Experiment on intervention with complement clitics

The third experiment investigated agreement in attraction configurations with a clitic intervener (Table 4).

Table 3
MR's performance on SPPV–VSPP grammatical judgments

	Inver	Gram	Errors	%	Sentences
SPPV	–	+	10/40	25	La nave dei soldati parte/Le navi del soldato partono The boat of the soldiers leaves/The boats of the soldier leave
*SPPV	–	–	19/40	47.5	*Le navi del soldato parte/*La nave dei soldati partono *The boats of the soldier leaves/*The boat of the soldiers leave
VSPP	+	+	6/40	15	Parte la nave dei soldati/Partono le navi del soldato Leaves the boat of the soldiers/Leave the boats of the soldier
*VSPP	+	–	27/40	67.5	*Parte le navi del soldato/*Partono la nave dei soldati *Leaves the boats of the soldier/*Leave the boat of the soldiers
	Total		62/160	38.7	

Table 4
M.R.'s performance on SubjcliticV - cliticVSubj grammatical judgments

	Inver	Gram	Errors	%	Sentences
ScliV	−	+	4/40	10	Il corridore li supera /I corridori lo superano The runner them overtakes/The runners him overtake
*ScliV	−	−	18/40	45	*I corridori lo supera/*Il corridore li superano *The runners him overtakes/*The runner them overtake
cliVS	+	+	4/40	10	Lo superano I corridori/Li supera il corridore Him overtake the runners/Them overtakes the runner
*cliVS	+	−	19/40	47.5	*Lo supera i corridori/*Li superano il corridore *Him overtakes the runners/*Them overtake the runner
	Total		45/160	28.1	

Four out of 40 (10%) errors were found with the pre-verbal grammatical items, SubjcliV. Performance was above chance level (z-score(1) = 5.05, $p > .005$) and differed significantly from performance in the ungrammatical condition, *SubjcliV, ($\chi^2(1) = 10.5956$, $p < 0.05$).

Few errors (4/40, 10%) were also found with the grammatical inverted items, cliSubjV. Here again, performance differed significantly from the ungrammatical inverted condition, *cliVSubj X, ($\chi^2(1) = 11.9603$, $p < 0.05$).

6. Discussion

In order to throw light on the instantiation of the functional lexicon in an aphasic speaker we studied her grammaticality judgments with respect to attraction effects in a variety of sentence configurations. This experimental stratagem was very revealing, resulting in significant effects that may be ascribed to a specific aspect of the participant's impairment. Many psycholinguistic studies with adults report interesting data with respect to agreement in attraction configurations. These studies consistently show between 4% and 11% agreement errors in production, a score significantly different from the baseline (no mismatched features), with most errors found in the Singular–Plural condition (see Frank et al., 2006 for an overview). The results from our experiment with an aphasic speaker corroborate the tendency reported in experiments with unimpaired control participants: a preference for attraction with interveners bearing marked features. Direct comparison of the data from production tasks with those from the present case study (grammaticality judgment) is not unproblematic, but it is interesting that the same tendencies emerge.

A further aim of the study was to explore the nature of grammatical preferences when implementation of the functional lexicon is impaired. In particular, we would like to highlight two important aspects of the results: the general fragile nature of post-verbal agreement and the nature of attraction effects related to disruption of the syntactic computation (as in cliticization).

6.1. On agreement and subject position

Guasti and Rizzi (2002) report data relating to the morphological manifestation of agreement and the possibility of establishing a local Spec–head configuration, such as in sentences with pre-verbal subjects. They found that when an AGREE operation is associated with Movement in a structural configuration, subject agreement has a stable morphological realization; otherwise, specific properties of individual grammars govern the morphological expression of agreement. Computation of Agreement is, therefore, determined by positional factors, and the present study supports this analysis.

M.R.'s low performance on VSubj ungrammatical items could be interpreted as a selective tendency to judge these items as grammatical, due to the fragile nature of post-verbal agreement in her impaired grammar. This tendency was not found in the ungrammatical pre-verbal subject condition, where M.R. correctly judged the ungrammatical SubjV items.[4]

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[4] It should be pointed out that we elicited post-verbal subjects in M.R.'s speech and found a similar distribution to that found with normal adults (see Garraffa, 2007 for details).

Furthermore, it is interesting to note that M.R. made most errors in the *VSubj condition with a singular verb and a plural subject (as in Parte le navi/*Leaves the boats*). Performance in this condition, *Singular/Plural, was at chance level (8/16).

The option of not marking agreement on post-verbal subjects is found in French, in some Italian dialects and is also present in certain standard grammars such as Arabic (see Brandi and Cordin, 1989; Guasti and Rizzi, 2002). M.R.'s grammar (she speaks standard Italian) appears to accord with these language variations and supports the view that the implementation of agreement is related to positional variables. What these data have in common is that movement appears to be a stabilizing factor in syntactic computation in a maximally transparent interface between form and position.

An interesting issue concerns the nature of M.R.'s non-standard performance in post-verbal subject agreement. Post-verbal subject agreement is weak and is subject to fluctuation in her grammatical system, although, as we have shown, this fluctuation is highly constrained. Following the generalization in (2) we can assume that non-configurational agreement based only on an Agree operation is difficult to perform for a non-fully active grammatical system. Subject Movement in a local Spec/Head dedicated position is a stabilizing factor in verifying grammatical features.

Concerning attraction, no evidence for linear intervention in VSubjPP was found. In the experiments with prepositional modifiers and object clitics with post-verbal subjects (VSubjPP and cliVSubj) grammaticality judgments showed a high level of accuracy.

On the other hand, the high error rate in the ungrammatical inverted conditions (*VSubjPP and *cliVSubj) supports the existing data indicating that post-verbal agreement is weak.

More interestingly, performance with *VSubjPP structures was below chance level (27/40; 67.5%), with most of the errors occurring in the Singular/Plural condition (17/20). In the ungrammatical inverted structures with clitics, *cliVSubj, we found performance at chance level and unrelated to any markedness effect. It is possible that clitics involve a different type of computation that makes such constructions more difficult.

We can conclude that with respect to agreement and subject position M.R. seems to be sensitive to the different syntactic computations involved. Interpretation of the computation in terms of locality conditions is crucial to a better understanding of SubjV agreement. We posit the existence of impairment in non-local configurations, such as agreement relations that involve the establishment of a connection between the pre-verbal position and the post-verbal subject.

6.2. On attraction and linear intervention

M.R.'s performance clearly shows attraction effects in [Subj-Prep]–Verb configurations, with a 25% error rate, higher than that generally attested in normal adult production (4–11%).

This result may plausibly be interpreted in terms of minimality effects induced by the agreement feature of the intervening prepositional modifier, a phenomenon that can be seen more clearly in an incomplete functional structure.

It has been suggested that sets of features normally associated with syntactic heads can be underspecified in cases of a reduced processing capacity and that this gives rise to selective minimality effects (see Grillo, 2005 and in the present issue for more details). Structures where a dependency is constructed over an intervening DP are more problematic to parse.

Attraction is readily explainable in terms of minimality, even in the absence of c-command; it offers a testing ground for the hypothesis sketched above.[5]

In judging misleading items, M.R. appears to consider both nouns as possible antecedents for the agreement relation with the verb. We presume that in a situation where processing cost is high (maintaining two agreement

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[5] For example, Rizzi (2002) maintains that *gapping* involves locality conditions in the absence of c-command. In a series of conjoined clauses, such as in (i), the missing verb can only be interpreted as identical to the closest overt verb (here *buy* and not *sell*):

i. John sells books, Mary buys records and Bill V newspapers (example from Rizzi, 2002: [9])

Rizzi also notes that a configurational condition is also at play in *gapping*, otherwise any linearly intervening verb would incorrectly block gapping:

ii. John wants to sell books, and Bill V to buy newspapers (example from Rizzi, 2002, footnote 4 [i]).

A linearly intervening verb, *sell*, does not block gapping. To formulate an intervention effect it seems to be necessary to qualify the intervener as a potential participant in the process for which Minimal Configuration is calculated. See Rizzi (2006) for a more detailed account of minimal configuration.

realizations before the verb form) the system is prone to error and even more so in linguistically impaired subjects (no effects were found with the control subject, and few in the study on normal adult production).

On the other hand, these data may be explained as a reflection of a possible competition strategy where the agreement specification of the subject position is copied onto the verb. Out of 10 errors, 8 were in the Sing/Plural condition. These data are in keeping with those obtained from adult French speakers (Frank et al., 2006).[6]

(18)   X   **...**   **Z**   **...**   **Y**

$[\ldots,\varphi_{[-number]}]$ $[\ldots,\varphi_{[+number]}]$ $[\ldots,\varphi_{[-number]}]$
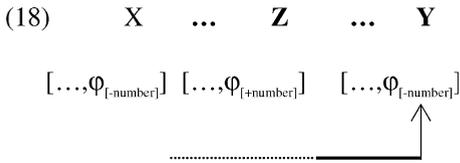
It is possible that the plural marking on an item, $X_{[+Number]}$, pre-activates the agreement-sensitive processes which check the grammatical feature of a following Y constituent. On the other hand, an unmarked lexical item, $X_{[-Number]}$, does not necessarily trigger any agreement checking related to the number feature. As a consequence, a higher expectation regarding the number of a following ''supposed-to-agree'' constituent should produce more processing difficulties if an agreement violation is detected on this last item. Furthermore, the hypothesis of an asymmetric system of licensing must be linked to an asymmetric grammatical process where formal features, such as number on verbs, need to be checked with an interpretable feature, such as number on nouns, but not the reverse.

An effect such as the one represented in (18) is more visible in aphasia due the abnormal nature of syntactic computation, especially in a non-local chain domain.

6.3. On attraction and movement

Unlike the adult French speakers tested by Frank et al. (2006), M.R. does not show any attraction effects with a clitic intervener (error rate 4/40; 10%).[7] This fact might seem surprising at first sight since the clitic intervenes not only linearly but also hierarchically. The clitic and verb heads are involved in a strong local relation, cliticization with finite verbs occurring in the same functional head. Other studies on aphasia have reported deficits in the production of clitic forms (see Chinellato, 2004; Rossi, 2007), showing that this specific grammatical computation can be problematic in aphasia.

Complement clitics involve a step in their derivation where they give rise to a crossed chain, as exemplified in (19).

(19) Il professore$_i$ li$_j$ legge [$_{VP}$ t$_i$ V t$_j$]

    The professor them reads

    The professor reads them
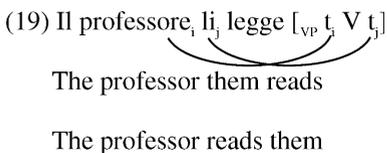
A crossed chain is a non-local computation; here a dependency is constructed over an intervening argument position. A non-standard feature specification of a head, as possible with a patient, may induce more selective locality effects in computations where a potential intervener must be crossed (see Grillo, 2005). Clitics are involved in a non-local computation and not (fully) represented in aphasic grammars since they are not able to cross the relevant subject position.

Regarding the performance of French adults reported in Frank et al.'s study (strong attraction effects due to clitic intervention), it is possible that in this language object clitics, being more similar to weak pronouns, have a different internal structure which gives rise to more errors (see Kayne, 1984).[8] This interpretation is also supported by a recent

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[6] The phenomenon of attraction seems then to be asymmetric and can be interpreted within a formalism which assumes syntactic features to be binary and implemented in terms of a marked value possessing a distinctive property, in this case (+ number), and an unmarked one (− number) lacking that property (Jakobson, 1957).

[7] Performance did not differ from the baseline, the matched condition ($\chi^2(1) = 0.5452$, $p < 0.5$).

[8] As pointed out by Kayne, the possibility of interrupting a clitic-verb sequence with an adverb occurs in some varieties of French.

unpublished study on early and adult French L2 learners where placement errors (pronouns produced in DP positions) were imputable to misclassification, all pronouns having been treated as weak. French, but not Italian, has weak pronominal subject pronouns. Absence of misanalysis in Italian in the present case study is limited to the few instances of weak pronouns, that is, the dative pronoun *loro* ('to them') and the uncommon subject pronoun *egli* ('they'). The result is that M.R. does not regard clitics as potential interveners. As pointed out by an anonymous reviewer, the main conclusion of this study is that there is no evidence for the weak status of clitic pronouns in Italian (Cardinalletti and Starke, 1999).

7. Conclusions

The present study was inspired by an analysis of the speech features of an aphasic patient. The aim was to analyze agreement relation in different syntactic environment in depth. In accordance with similar evidence reported in the literature, M.R. has quite good comprehension but a production deficit on functional words. Since we do not wish to claim any unique representational source for the deficit, there is no reason, in principle, to suppose the existence of a ''modality independent'' structural reduction. This study dealt with grammaticality judgments; complementary experiments could be carried out in the future to test similar paradigms in speech production. We consider that the nature of the parser in non-fluency, the extent to which temporal order is a property of structure building and the exact nature of the deficit manifested by a reduction in processing capacities are central issues in neurolinguistics. As an example, in the present paper we present data from processing in adults (De Vincenzi et al., 2006) that deal with a familiar distinction reported in aphasia, the split performance with Tense and Agreement inflection, and we speculate on the procedural nature of the deficit based on a reduction in processing abilities. These are pervasive constraints of the language faculty, the nature of which is an intriguing and challenging topic of investigation.

The findings reported in this study argue in favor of a selective deficit in the functional lexicon of the aphasic speaker investigated. The functional lexicon in aphasics is a useful source of empirical data, in particular if we select phenomena where the impairment can be structurally defined according to a specific linguistic model. The implementation of functional elements plays a central role in syntactic structure building and analyzing the different configurations involved in subject–verb agreement can highlight it. Starting from well-attested evidence showing unimpaired performance with pre-verbal SubjV agreement, we looked at more complex computations involved in checking number agreement. The main question of this study concerns to what extent a reduction in processing capacities can impair implementation of the functional lexicon. The conceptual guideline is that features bearing morphosyntactic information may be differently parsed in line with theoretical evidence from linguistic models. A damaged system selects Minimal configurations compatible with grammatical principles. A Minimal configuration is here defined as a local configuration. Non-local relations, in the sense of chain formation, are susceptible to intervention effects and are more costly to implement. We report evidence from our case study in support of a deficit in the computation of syntactic chains, in particular where dependencies are constructed over possible interveners (see Grillo, 2005).

Our findings also have implications for linguistic theory; data from both comparative syntax and neurolinguistics show that pronominal clitics differ in certain Romance languages.

In particular, there is no evidence for the weak status of clitic pronouns in Italian, unlike in French where the presence of weak subject pronouns plays a role in attraction effects.

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