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PROCESSING CLITIC PRONOUNS IN BULGARIAN – EVIDENCE FROM NORMAL AND AGRAMMATIC COMPREHENSION

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ABSTRACT

Clitic clusters display a complicated interaction of prosodic and syntactic properties which determines their word order and stress patterns. In Bulgarian, short pronouns appear as unstressed verbal enclitics in positive utterances. Proclitic negation attracts the pronouns and forms with them a prosodic unit stressed on the second syllable, the pronoun. Theoretical linguistics characterizes the behaviour of object clitics in terms of "non-trivial chains" (Bošković 2001) containing copies. The overt realisation of a higher or lower copy depends on phonological constraints like enclitisation requirements. In line with the slow-syntax-hypothesis (Burkhardt et al. 2008) and with the assumption that prosody-related processes may also compete for the same limited processing resources of Broca's aphasics (Avrutin et al. 1999), we test sensitivity to the phono-syntactic constraints negation imposes on the word order of personal and reflexive clitics. Results suggest that the pattern of agrammatic processing of clitic clusters resembles normal comprehension but proceeds in a protracted manner. Employing a self-paced reading task and an experimental design which reduces discourse-related interpretation processes, we also show that the syntactic functions of personal object clitics as syntactic object agreement markers in Bulgarian are relatively preserved in the aphasic group.

KEYWORDS: Agrammatism; Bulgarian; clitic cluster; self-paced reading.

1. Introduction

Bulgarian is a discourse-configurational pro-drop language without nominal case marking (Kiss 1995). Bulgarian features several types of clitic elements, such as pronominal and auxiliary clitics, the negative proclitic *ne* 'not' and the question particle *li*. These, in their nature very different, elements form a clitic cluster which cannot be penetrated by other lexical material. Contrary to the free word order of nominal constituents, clitic placement in the cluster follows a rigid order. The clitic cluster represents an independent prosodic unit which must be adjacent to the verb. The word order of the clitics

within the cluster and its regular position with respect to the verb as presented in (1) is illustrated in (2).

(1) neg aux dat acc V

(2) Ti$_{2SG\ NOM}$ ne$_{NEG}$ si$_{AUX\ 2SG\ PRES}$ mu$_{3SG\ DAT}$ go pokazal.
You not are him it shown.
'You have not shown it to him.'

In Bulgarian, personal (in the oblique case) and reflexive pronouns exhibit two forms: full tonic pronouns like *mene* 'me', *sebe si* 'myself', and their short unstressed counterparts *me* and *se*, respectively. The functional distribution of full and short forms is associated with topic/focus distinctions and is regulated by prosodic properties. Long forms are used e.g. in constructions with contrastive focus and with prepositions, while short forms are required for the marking of topic referents (Nicolova 1986).

From a syntactic point of view, the short pronouns in Bulgarian are verbal clitics. They form a morpho-syntactic unit with the verb. Phonologically, they are enclitic elements as they cannot appear sentence initially. In such cases they have to be hosted by the verb and appear in a post-verbal position. Consider the position of the clitic cluster in (3), in which the subject pronoun is dropped.

(3) Pokazal si $_{AUX\ 2SG\ PRES}$ mu $_{3SG\ DAT}$ go $_{3SG\ ACC\ MASC/NEUTR}$
Shown are him it.
'You have shown it to him.'

Clitic pronouns and clitic clusters exhibit a complicated interaction of prosodic and syntactic properties which determines word order and stress patterns in the phonological output (see Werkmann 2003 for an extended overview and discussion of syntactic approaches to clitic placement in Bulgarian).

In this paper, we investigate the processing of direct object pronominal clitics under negation which regularly build together a clitic cluster (Rå Hauge 1999). Negation is a functional category overtly realised as a verbal proclitic. In case of predicate negation, no adverbs may intervene between the negative marker and the verb. The presence of negation has a significant impact not only on the interpretation of the utterance, but also on the derivation of syntactic structure and its prosodic properties after spell-out. In case of narrow scope constituent negation, the negative marker selects a long pronominal form (4a), while a short pronoun is ruled out (4b).

(4a) Ne nego $_{LONG\ 3SG\ ACC\ MASC/NEUTR}$ viždam, a neja $_{LONG\ 3SG\ ACC\ FEM}$
(4b) Ne *go $_{CL\ 3SG\ ACC\ MASC}$ viždam, a *ja $_{CL\ 3SG\ ACC\ FEM}$
Not him see but her
'I see her not him.'

In the case of wide-scope sentential negation, the negative marker combines only with a short pronominal form. The proclitic negation attracts the enclitic short pronoun and they form a prosodic unit by mutually satisfying their prosodic requirements. The resulting clitic cluster is stressed on the second syllable, the pronoun (5). The negative marker and the direct object clitic yield together a prosodic unit with an iambic stress pattern. The stress pattern of the clitic cluster thus exemplifies the generally iambic rhythm of Bulgarian speech.[1] The cluster attaches itself to the verb, barring other lexical material from intervening between them. In contrast to the direct object clitics, nominal objects do not move in front of the verb in case of sentential negation (6). In positive sentences, pronominal clitics appear after the verb if sentence initially there is no lexical material to support them (7).

(5) Ne gó CL 3SG ACC MASC/NEUTR vižd**am** 1SG PRES.
Not him/it see
'I don't see him/it.'

(6) Ne vižd**am** 1SG PRES deteto.
Not see the child.
'I don't see the child.'

(7) Vižd**am** 1SG PRES go CL 3SG ACC MASC/NEUTR.
See him/it
'I see him/it.'

Given this distribution, we need a more precise idea of the syntactic and prosodic mechanisms which determine it, and which inevitably influence both production and comprehension of negative sentences. In order to better understand how sentence comprehension proceeds, we need to consider not only such factors as frequency, length and phonological salience, but also syntactic and prosodic factors which increase the predictability of structure building and thus support the incremental integration of lexical elements.

Online experimental data on the processing of sentences involving clitic clusters may deepen our understanding on the nature of the phonology-syntax interface. The comparison of normal processing data with language breakdown data from agrammatic aphasics may yield valuable insights in two respects. First, under the assumption that agrammatism is due not to a general syntactic deficit, but to a slowed-down implementation of syntactic operations (Burkhardt et al. 2008; Burkhardt 2005; Haarman and Kolk 1994; and Piñango 2002, inter alia), we expect the agrammatic data to work as a

[1] Consider a comparison between Bulgarian and German, both of which are not fixed-stress languages. However, their general speech rhythms exhibit opposite patterns: iambic in Bulgarian and trochaic in German.

magnifying lens to the healthy system. Through such a comparison, we can learn more about the relative influence of syntactic and prosodic features on clitic placement.

Second, the study approaches questions concerning the tacit knowledge of clitic properties that aphasic individuals may have preserved. Due to their status as unaccented functional elements, pronominal clitics often lack in agrammatic speech (for cross-linguistic evidence see Rossi 2007; Stavrakaki and Kouvava 2003; and Menn and Obler 1990, inter alia). With respect to the sensitivity to stress and prosodic information, some studies have presented evidence that brain damage in the left hemisphere causes a general prosodic deficit which for sentence comprehension is manifested by difficulties to utilise linguistic prosodic cues (Baum et al. 1982; Cappa et al. 1997; Pell and Baum 1997). In a similar vein, Burchert et al. (2005b) argue that agrammatic individuals do not profit from contrastive stress for the discrimination of unambiguously case-marked sentence constituents.

The study of Avrutin et al. (1999) on the impact of contrastive stress on the interpretation of English pronouns shows mixed results. The study uses a picture-selection task with stimuli of the type *First John hit Bill and than Mary hit him/HIM* in which the stressed pronoun refers to the subject *John* while the unstressed pronoun refers to object *Bill* of the first clause. Although the aphasic group performed at chance level in both conditions, the direct comparison of object choices reveals that in the stressed condition the rate of object selection is significantly lower. In other words, the results of the stressed condition hint at some preserved abilities with respect to comprehension of stress as a reference determiner. The authors conclude that Broca's aphasics may not be able to implement this prosodic cue to a full extent during a discourse-based reference establishment. They reason that the complexity of the applied task may attenuate the effect of prosody and advocate tasks which target stress-induced morpho-syntactic operations and thus avoid discourse processing.

The present experiment was designed to reduce interpretation efforts as far as possible. It examines the impact of the phono-syntactic properties of negation on clitic cluster formation by targeting sensitivity to position violations during reading. The self-paced reading task uses negative imperatives as stimulus sentences. Imperatives have an advantage over finite clauses against the background of converging on- and offline experimental findings which locate the source of agrammatic behaviour at the structural and notional representation of tense (Burchert et al. 2005a; Faroqi-Shah and Dickey 2009; Yarbay Duman and Bastiaanse 2009; Wenzlaff and Clahsen 2004), and strengthen the notion that tense disturbances do not necessarily prune the syntactic structure (Burchert et al. 2008; Dickey et al. 2008; Stavrakaki and Kouvava 2003). Additionally, the experiment seeks to contribute to the discussion revolving around differences in the comprehension of personal and reflexive pronouns. We explore the hypothesis that the processing load of reflexive and personal pronominal clitics may vary with respect to different phono-syntactic environments and with respect to the availability of potential referents.

The paper is organised as follows. Section 2 provides a background on the linguistic assumptions underling the experiment. Section 3 describes the experimental method in terms of participant groups, procedure and materials. Section 4 presents the experimental results and a comparison between the processing patterns obtained from normal and agrammatic comprehension of pronominal clitics in negative imperatives. A discussion of the experimental findings with respect to the aims of the study and a general conclusion follow at the end.

2. Linguistic background

2.1. What determines clitic placement in Bulgarian?

In the literature on clitic placement in Bulgarian, the discussion revolves around the mechanisms guiding pre-verbal or post-verbal realisation of clitic elements. Leaving aside conceptual differences about the status of clitics as heads (Rivero 1994; Franks and Rudin 2005; Werkmann 2003) or non-branching maximal projections (Bošković 2001, 2002), the trigger and the landing site of their movement, all syntactic accounts agree that syntactic derivation moves the clitics to the left of the verb. The syntactic approaches diverge with respect to their accounts of the structures in which the pronominal clitics are realised in a post-verbal position. At this point, the prosodic properties of clitics start to play a role for the spell-out of the syntactic structure. The discussion revolves around the availability of movement at the level of PF. Indeed, some of the strongest arguments for the existence of Prosodic inversion (Halpern 1992, 1995) are based on clitisation in South Slavic. Among others, Rudin and her co-authors (1997, 1999) and Caink (1999) argue that clitic placement in Bulgarian appeals to prosodic inversion in some configurations.

Another approach which takes into account the special prosodic status of clitic elements but leaves clitic placement a matter of syntactic derivation is proposed by Bošković (2001). After an extensive survey of clitic position patterns in South Slavic languages, he presents an analysis in terms of non-trivial chain formation. Under this approach, syntactic movement of the verb and of the clitic elements creates a chain of copies, not of traces (Chomsky 1993). This is a relevant difference as in a chain of traces, only the head of the chain is supposed to be the location of the phonological form. No such restriction applies to a non-trivial chain of copies (8). The overt realisation of copies is regulated by the same principle unless the pronunciation of the head copy would result in a violation of phonological requirements.

In Bulgarian, copy movement places a pronominal clitic in front of the verb while leaving a lower copy in a post-verbal position (9a). In case no lexical material is located in front of the clitic (9b), the head of the non-trivial chain is left unsupported, which produces an ill-formed construction. Pronunciation of the next lower copy satisfies the enclitisation requirement of pronominal clitics allowing for the enclitic element to be hosted by the verb (9c).

(8) clitic $_{\text{head of chain}}$ Verb clitic $_{\text{lower copy}}$

(9a) Az go $_{\text{head}}$ kupix ~~go~~ $_{\text{lower copy}}$.
(9b) *Go kupix ~~go~~.
(9c) ~~go~~ Kupix go.
'I bought it.'

The prosodic constraints on clitic pronouns determine which copy has to be realised overtly. All other copies are deleted. In the presence of negation, the phono-syntactic properties of the post-stressing negative marker interact with those of the pronominal clitics and induce the pronunciation of the highest element of the pronominal chain. In Bulgarian, the negative marker *ne* heads its own functional projection NegP which is situated higher than TP. In imperative sentences which do not have TP, NegP is above Agr_SP (Tomić 2005). Negation as a verbal proclitic does not influence the stress pattern of the adjacent verb, but it induces stress on the pronominal clitic adjacent to it in the clitic cluster. In the clitic cluster, the negative particle is the first syllable of the phonological word while the direct object clitic is the last one. The verb is immediately adjacent to the cluster and therefore to the direct object clitic. Knowledge about the phono-syntactic properties of the negative marker guides the structural expectation and the integration of subsequent information chunks during the processing of negative sentences containing pronominal clitics.

2.2. Specific properties of personal and reflexive direct object clitics

In a cluster containing negation and a direct object clitic, two different pronominal types may appear: a personal pronoun and a reflexive pronoun. They are object to the same phono-syntactic restrictions and occupy the same direct object position. Nevertheless, they exhibit quite a different referential behaviour. Reflexive pronouns and, more specifically, direct object reflexive clitics establish a co-reference relation to the sentential subject based on syntactic principles. In contrast, pronominal direct object clitics do not refer to the sentential subject apart from some very restricted cases. The definition of the principles guiding the interpretation of reflexives and pronouns has undergone considerable changes during the last decades. Consider for instance the three major approaches: Government and Binding, Reflexivity (Reinhard and Reuland 1993) and Primitives of Binding (Reuland 2001). A discussion of these developments is beyond the scope of the present paper. Notwithstanding their differences, all three approaches provide evidence that the bound interpretation of a reflexive pronoun is structurally based. The last approach, Primitives of Binding, involves economy considerations which makes it more accessible for psycholinguistic research. In sum, the interpretation of a reflexive object clitic results from syntactic operations and is carried out within the sentence boundaries (see an extended discussion in Ruigendijk et al. 2006). The inter-

pretation of a personal object clitics depends on the contextual availability of referents which may or may not be provided in the same sentence. Thus interpretation of pronouns depends on the establishment of a discourse model and the search of appropriate referents in it (see Avrutin 1999 and Burkhardt 2005 for a discussion of the syntax-discourse interface).

Apart from the mechanisms concerning the interpretation of reflexive and personal pronouns, these two pronominal types have different effects on the predicate they are attached to. If the direct object position of a transitive predicate is occupied by a reflexive pronoun, the arity of the predicate is reduced. Reflexive clitic pronouns in Bulgarian are not specified for person, gender and number. The only distinction they express is that of case: *se* is the direct object form, and *si* the indirect object form of the reflexive clitic. The co-reference establishment between the direct object reflexive clitic *se* and the subject yields argument reduction of the otherwise two-place predicate (see Grimshaw 1990 for a discussion of the argument absorption induced by reflexive pronouns).

With respect to the function of personal object clitics in Bulgarian, we find a broad consensus between different theoretical approaches. The close association of the clitics with the verb and the precise analysis of the clitic doubling phenomenon have lead to the conclusion that the clitics are best understood as syntactic object agreement markers. Although they do not have reached the status of the bound verbal inflection affixes which license the subject drop in Bulgarian, they have acquired similar functions for licensing object drop (Stanchev 2007). Within the generative framework, pronominal clitics have been defined as functional heads (Rudin et al. 1999; Franks and Rudin 2005) or non-branching XPs (Bošković 2002) which check their features at the respective AgrP. According to the split-IP hypothesis (Pollock 1989) scrutinised for Bulgarian by most of the authors,[2] the functional projections $Agr_{IO}P$ and $Agr_{DO}P$ are situated below TP in the syntactic structure. These syntactic characteristics of the direct object clitics have interesting processing implications, especially in the cases where co-reference establishment has to be postponed due to unavailability of discourse referents.

3. Method

To evaluate the processing of pronominal clitics in clitic clusters and to assess participants' knowledge of phono-syntactic constraints on clitic placement under negation, a self-paced reading task was employed. We used a stationary window method for a word-by-word presentation of positive and negative imperative sentences with reflexive and personal direct object clitics. The contrast between these pronoun types provides for a better distinction between the relative weight of processes induced by the syntactic and by the referential properties of clitic pronouns in the course of sentence comprehension.

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[2] See i.e. Rudin (1997) who suggests for Bulgarian the following structure: [CP[MP[NegP[MP2[T/AgrSP [AgrIOP[AgrDOP[AuxP[VP…]]]]]]]]].

3.1. Participants

Nine individuals (6 male and 3 female) diagnosed with Broca's aphasia after a CVA in the left hemisphere and 31 unimpaired controls (17 male) participated in this experiment. All participants are native monolingual speakers of Bulgarian. The aphasic participants were moderately to severely impaired according to their scores in the Bulgarian version of the Boston Diagnostic Aphasia Examination (Alexandrova et al. 1996) and clinical consensus. They ranged in age from 32 to 59 (mean age 49.7) and were at least 4 months post-onset at the time of testing.

The speech production of all patients was non-fluent with short utterances, breaks and automatisms. Transcriptions of free conversation samples and retelling of *The Little Red Riding Hood* story reveal that they rarely produce pronominal clitics and even fewer clitic clusters. All aphasic participants showed a preserved comprehension of commands. Demographic and general language tasting data for the aphasic participants are provided in Table 1.

Table 1. Demographic data on the aphasic group.

Subject	Sex	Age	Years of education	Months post-onset	Etiology	Severity rating	Fluency rating	Comprehension of commands-15
KM	f	45	11	3	LCVA	4	4	15
DY	m	32	11	12	LCVA	1	2	13
MP	m	46	16	46	LCVA	4	3	15
AR	f	55	16	64	LCVA	4	4	14
MB	f	46	16	5	LCVA	3	3	15
DD	m	59	12	35	LCVA	3	3	15
IH	m	51	11	29	LCVA	3	2	15
TM	m	54	16	17	LCVA	4	4	15
MM	m	59	16	29	LCVA	1	1	11

The performance of the non-fluent speakers was compared to the performance of a group of 31 Bulgarian non-brain damaged speakers matched in age and education. The control participants ranged in age from 31 to 60 years (mean age 48.7) and reported no prior history of language-, learning- or neurological impairments.

3.2. Materials and procedure

We used 3 types of short imperative sentences to test sensitivity to violations of the well-formedness restrictions on clitic placement under negation. Each sentence type comprised 40 sentences. The first type included well-formed sentences in which the

proclitic negative particle *ne* and the pronominal enclitic form a clitic cluster. This clitic cluster procliticises to the verb, and no other elements may intervene between the clitic cluster and the verb. In the clitic cluster, the direct object clitics appear pre-verbally and receive stress (10). The second sentence type features ungrammatical negative imperatives. The ill-formedness results from the post-verbal realisation of the pronoun, as an enclitic (11). The enclitic position violates the phono-syntactic well-formedness requirement of clitic cluster formation under negation. The third sentence type presents well-formed positive imperative sentences in which the pronoun is realised in a post-verbal position, as there is no other clause-initial material to host the phonologically enclitic pronoun (12). This sentence type serves as a base line instantiating the processing of enclitic pronouns.

(10) Well-formed negative imperatives with pronouns in a pre-verbal position (clitic cluster)

(10a) Molja te, ne go PERS 3SG MASC/ NEUTR ACC krij otzad!
Please, not it/him hide behind
'Please, don't hide it behind!'

(10b) Molja te, ne se REFL ACC krij poveche!
Please, not yourself hide more!
'Please, don't hide any longer!'[3]

(11) Ill-formed negative imperatives with pronouns in a post-verbal position

(11a) Molja te, ne krij *gi PERS 3PL ACC sega.
Please, not hide them now
'Please, don't hide them now.'

(11b) Molja te, ne krij *se REFL ACC tuka!
Please, not hide yourself here
'Please, don't hide here.'

(12) Well-formed positive imperatives with pronouns in a post-verbal position

(12a) Molja te, krij go PERS 3SG MASC/NEUTR ACC bărzo!
Please, hide it/him fast
'Please, hide it/him fast!'

[3] The English translation may be misleading, as the verb *hide* freely appears as a one-place predicate. In Bulgarian, the transitive verb *krija* 'hide' is a regular two-place predicate, and it becomes subject to arity reduction only if used reflexively.

(12b) Molja te, krij se $_{\text{REFL ACC}}$ dobre!
Please, hide yourself well
'Please, hide well!'

In order to check the impact of syntactic binding on the processing of clitic pronouns, we contrasted personal direct object clitics with reflexive clitics. We selected 20 transitive verbs and used them iteratively with personal pronouns (10a–12a) and with the reflexive pronoun *se* (10b–12b). We used direct object pronouns in the3rd person plural *gi* 'them' and in the 3rd person singular *go* 'it/him'. The latter is underspecified for masculine and neuter gender, as well as for the animacy of potential referents. The selected personal direct object clitics are of the same length as the reflexive pronoun *se* which is underspecified for number, person and gender and only marks accusative case.

In the present test, the participants can determine the referent of the pronominal clitics only when reflexive pronouns are used. The establishment of a co-reference relation between the reflexive pronoun and the second person subject of the imperative sentence is guided by syntactic computation. In contrast, the sentences containing personal pronouns do not provide any information about possible referents. Co-reference establishment between the 3rd person clitics and the 2nd person singular non-overt subject is blocked by the mismatch of agreement features. Without contextually available referents, the direct object clitics only function as object agreement markers in the present stimuli.

In addition to the 120 stimuli of the present experiment, there were 240 other sentences from 2 other experiments, one third of which contained different types of ungrammatical sentences. The other two experiments investigated comprehension of aspectual restrictions under negation in analytic and synthetic imperative constructions (Kuehnast 2003). Their stimuli involved only nominal objects. All sentences together yielded a 2:1 ratio of well-formed to ill-formed stimuli. The stimuli of the three experiments were randomised and complemented with comprehension questions after every third sentence. The stimulus set was divided into 6 parts, each lasting 10 to 15 minutes. Each part started with 5 training sentences. The aphasic individuals performed 1 or 2 parts per session followed by a break of 3 to 5 days. The control group performed the whole experiment in one session with short breaks between the parts, and one major break after the 3rd part in which they were given an off-line task.

The experiment uses a self-paced reading task with a stationary window. The participants were instructed to read silently the sentences which could be well-formed or ill-formed, and to concentrate on the meaning of the sentences in order to answer comprehension questions. They were told to read the imperative sentences as if they were expressing the requests themselves and to understand the questions as clarification questions posed by the addressee of the requests. After a fixation cross, each sentence appeared word by word in the middle of a laptop screen. The end of the sentence was signalled by an exclamation mark presented together with the last word. The participants read the sentences at their own pace by pushing a response button. Yes/No an-

swers to the comprehension questions and response latencies were obtained by pressing either a green or a red response key labelled Yes and No in Bulgarian capital letters. An example of a request and an a clarification question is presented in (13–14).

(13) Imperative sentence

Molja te,	drăzh $_{\text{2SG IMP IMPF}}$	go $_{\text{PERS 3SG ACC}}$	otdolu!
Please,	hold	it	beneath

'Please, hold it at the bottom!'

(14) Clarification question

Otdolu	li	da	go $_{\text{PERS 3SG ACC}}$	dărzha $_{\text{1SG PRES IMPF}}$?
Beneath	question particle	that	it	hold

'Should I hold it at the bottom?'

3.3. Relevant data

Reaction times (RTs) to each word in the imperative sentences, answers and response latencies for the comprehension questions were recorded automatically in milliseconds by means of the psycholinguistic program ERTS.[4]

The clitic pronoun and the word following the pronoun are taken to constitute the critical processing region in the experimental stimuli. The response latencies measured at these two points are supposed to reflect processing effects relevant for the present research questions. Therefore, the mean RT to the clitic pronoun and the mean RT to the word following the pronoun are the dependent variables in the current experimental design. The obtained RTs were trimmed by excluding values of more than 3000 ms or less than 200 ms, as well as outliers with more than 2.5 standard deviations above or below the mean RT for each participant per condition. This process excluded 5.9 % of the control participants' data and 7.1 % of the data of the aphasic participants.

In the well-formed negative sentences, the verb is adjacent to the clitic cluster and thus immediately follows the pronominal clitic. In the other two sentence types, the verb precedes the clitic pronoun, which is followed by a manner adverb or by a preposition introducing a locative or an instrumental prepositional phrase. While all verbs are two-syllabic and feature 4 to 6 characters, the adverbs and the prepositions differ in length. Therefore, the words following the clitics were assigned to one of three length groups: short length (1–3 characters), middle length (4–6 characters) and long length (7–9 characters). Subsequently, we calculated the mean RT for each word length group per person and per condition. Here we report analyses which are based on the mean RTs of the words of middle length in order to avoid word length confounding the comparison between the mean response latency for the verb and those for the adverbs.

[4] Experimental Run Time System software and gear (ERTS, BeriSoft, Germany).

4. Results

Below, we present separate statistical analyses for each participant group. With respect to processing of pronominal clitics, Bulgarian is an under-researched language and we need to establish a pattern of regular processing first. The pattern obtained from the aphasic data will be compared to the established norm. Mean reaction-time data are presented by the condition for the control group in Table 2 and for the aphasic group in Table 3.

Table 2. Reaction time data of the control group per condition.

Sentence type	Pronoun type	Clitic mean RT (ms)	SE	Next word mean RT (ms)	SE
Pos + post-verbal	reflexive	618	23	838	29
	personal	586	22	612	30
*Neg + post-verbal	reflexive	612	23	857	45
	personal	579	22	864	42
Neg + pre-verbal	reflexive	603	23	691	27
	personal	552	21	626	28

SE – standard mean error.

4.1. Control group

We conducted a repeated measures analysis of variance (ANOVA) on the RT to the pronouns with pronoun type (personal, reflexive) and sentence type (positive, post-verbal clitic; negative post-verbal clitic and negative, pre-verbal clitic) as within-subject factors. The analysis revealed main effects of sentence type ($F(2,29) = 7.492$, $p = .002$) and of pronoun type ($F(1,30) = 71.445$, $p < .001$), and no significant interaction between them ($F(2,29) = 1.507$, $p = .239$). The main effect of sentence type shows that pronominal RTs differ mainly as a result of their position. Pronouns are read significantly faster when they appear pre-verbally as a part of a clitic cluster than when they appear in a post-verbal position. The well-formedness of the sentence is less decisive for the RT elicited by pronouns. The pair-wise comparison shows that post-verbal pronouns in the well-formed positive sentences are not read faster than those in the ill-formed negative sentences (596 ms). Within the negative conditions, the erroneous post-verbal clitics tend to be read more slowly than the pre-verbal ones ($p = .064$). The main effect of pronoun type and the lack of an interaction with sentence type show that reflexive clitics are always read more slowly than the personal clitics (see Fig. 1).

Next, we examined the RT elicited by the word which follows the pronominal clitic applying the same factorial analysis as reported above. We found a main effect of sen-

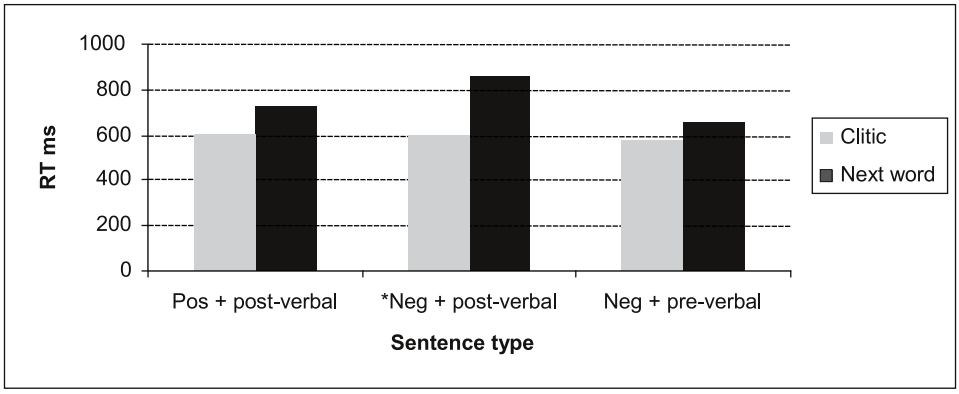

Figure 1. Normal processing pattern per sentence type – RT (ms).

tence type ($F(2,29) = 22.867$ $p<.001$) and of pronoun type ($F(1,30) = 68.313$, $p < .001$), and a significant interaction between them ($F(2,29) = 29.519$, $p < .001$). The main effect of sentence type reveals sensitivity to the well-formedness of the tested sentences. The RT elicited by the adverb in the ill-formed negative condition (861ms) is significantly slowed down as compared to the RT elicited by the verb in the well-formed negative sentences (mean 659 ms), and to the RT to the adverb in the well-formed positive sentence (725 ms). The pair-wise comparison between the conditions featuring post-verbal clitics also shows a grammaticality effect on the processing speed. In the well-formed positive sentences, the adverbs are read significantly faster than in the ill-formed negative sentences ($p = .009$). The main effect of pronoun type shows that words following reflexive clitics exhibit longer RTs than words following personal object clitics. The significant interaction between the two factors reveals that the effect of pronoun type disappears in the ill-formed negative condition. There was no difference between RTs elicited by the adverb following either pronoun type when the clitic appears in the phono-syntactically erroneous illegal post-verbal position.

4.2. Broca's aphasics

We performed the same repeated measures factorial analysis (a 3 × 2 sentence type by pronoun type ANOVA) on the mean RT data elicited by the aphasic patients in the critical region of the test sentences, the clitic pronoun and its next word. For the RT data to the clitic pronouns, we found a main effect of pronoun type ($F(1,7) = 5.588$, $p = .043$), but no effect of sentence type and no interaction between the factors. The main effect of pronoun type and the lack of an interaction with condition reveal that the aphasics take longer to read reflexive clitics as compared to personal object clitics in all conditions. With respect to the factor condition, there is no general differentiation in the RT to cli-

tics in post- and pre-verbal position. The pair-wise comparisons, however, reveal sensitivity to the well-formedness constraint on the position of a clitic in negative sentences. Under negation, pronouns in the clitic cluster are read significantly faster then the misplaced ones ($p = .01$).

Table 3. Reaction time data of the aphasic group per condition.

Sentence Type	Pronoun type	Clitic mean RT (ms)	SE	Next word mean RT (ms)	SE
Pos + post-verbal	reflexive	1269	57	1524	154
	personal	1215	89	1421	186
*Neg + post-verbal	reflexive	1446	193	1635	194
	personal	1423	195	1707	199
Neg + pre-verbal	reflexive	1243	168	1519	176
	personal	1266	177	1362	148

SE: standard mean error.

The analysis of the aphasic RT to the word following the pronominal clitics reveals no effect of pronoun type ($F(1,8) = 2.153$, $p = .180$), but a main effect of sentence type on the edge of significance ($F(2,7) = 4.718$, $p = .050$). There is a significant interaction between the two factors ($F(2,7) = 6.535$, $p = .025$). The effect of sentence type is due to the significantly slower RT to the adverb following the clitic in the ill-formed negative sentences as compared to the RT to the verb in the well-formed negative sentences. Within the well-formed sentence types, the presence of negation does not facilitate the RT to the verb as compared to the RT to the adverb in the positive sentences. The significant interaction between the factors pronominal type and sentence type shows that in the well-formed negative condition the aphasic persons take longer to integrate the verb after a reflexive clitic than after a personal object clitic. In the other conditions, and especially in the ill-formed negative condition, the pronominal type does not influence the time the aphasics need to integrate the adverb into the sentential structure.

5. Discussion

Based on the theoretical considerations discussed above, the following predictions can be made about the pattern of normal processing in the investigated sentence types. Firstly, we expect that the response latencies obtained for the critical region of the well-formed negative sentences will be the shortest. In these sentences the pronoun appears in the clitic cluster. This means that the pronoun is overtly realised in the position where

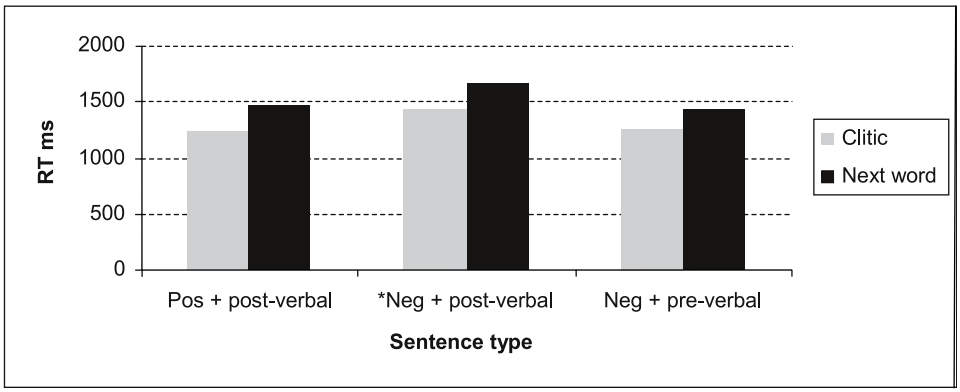

Figure 2. Aphasic processing pattern per sentence type – RT (ms).

the syntactic derivation has put it, namely in front of the verb. The prosodic requirements of the proclitic negation and of the enclitic pronoun are mutually satisfied through cluster formation. In this case, prosodic and syntactic cues converge. Sensitivity to the phono-syntactic properties of the clitic cluster increases structure predictability and speeds up lexical access to the verb.

Secondly, with respect to the overt realisation of a lower copy in the ill-formed negative sentences, we expect that the split of the clitic cluster will elicit slowed-down RT to the displaced pronoun and to the next word as a reflection of accommodation and recovery processes. This expectation holds for the comparison with the RT elicited by the pronouns in the cluster as well as for the comparison with the RT elicited by the post-verbal pronouns in the positive imperatives.

Thirdly, we expect a "cluster bonus" in the processing of pronouns and verbs in the well-formed negative imperatives as compared to the processing of pronouns and adverbs in positive imperatives. The positive imperatives represent a construction type in which the mismatch between the enclitisation requirement of the pronoun and the syntactic derivation results in the overt realisation of a lower copy. The transitive verb appears sentence-initially which given the free word order in Bulgarian does not facilitate structural expectations towards a direct object at the clitic position.

For agrammatic processing, our predictions are guided by the assumption that the aphasic patients exhibit a deficit in processing prosodic information and a slowed-down implementation of syntactic operations. Therefore we predict that the pronouns will elicit similar RTs in all sentence types as the realisation of a lower copy does not represent a syntactic violation. However, if the aphasic individuals are sensitive to the phono-syntactic constraints negation imposes on the position of pronominal clitics, but suffer from a timing deficit in the implementation of their prosodic knowledge we expect to find in the critical region a RT pattern similar to that of the control group.

The effects of sentence type revealed by the statistical analysis of the mean RT obtained at the two critical points show that the predictions about normal processing are borne out. The control group process clitic pronouns in the clitic cluster faster than those in a post-verbal position. No RT difference was found between the pronouns in enclitic position despite the well-formedness contrast of the positive and the negative imperatives containing them. Unimpaired participants seemingly do not notice the violation of the phono-syntactic requirement of cluster formation in the presence of negation in sentences featuring an overt realisation of the lower copy. That this is indeed not the case is revealed by the response latencies obtained for the words immediately following the pronominal clitics (see the analysis of the second dependent variable). Compared to the RT elicited by the adverbs in the positive imperatives, the adverbs following the lower copy in the negative imperatives take significantly longer to be read. The slowing down of the response latency after erroneously placed pronouns is indicative of the spill-over effect induced by the increase of processing load through the word order violation. As predicted, the verbs following the clitic cluster elicit the fastest RT due to their high structural predictability.

With respect to the aphasic comprehension data, we observe that the response latencies elicited by the pronominal clitics do not differ in the three sentence types. Although the pronouns elicited the slowest RT in the ill-formed negative imperatives, the difference to the RT in the other two sentence types did not reach significance. Similarly, the aphasic group seems not to profit from the convergence of prosodic and syntactic cues expected to facilitate the integration of the pronouns in the clitic cluster as compared to the low structural predictability of the enclitic pronouns in the positive sentences.

In a sense, all employed sentence types (including the ill-formed one) satisfy the enclitisation requirement of the pronominal clitics, but not all satisfy the cluster formation requirement of the negative clitic. The obtained pattern may be interpreted as evidence that the aphasic speakers do not react to the phono-syntactic properties of the negation marker against the background that the ill-formedness of the post-verbally realised clitics results from the presence of negation. The RT data obtained at the next word, however, shows that the above interpretation cannot be fully supported. The adverbs in the ill-formed negative sentences yielded the longest mean response latency. It is significantly slower than the one elicited by the verbs in the well-formed negative imperatives. The obtained result mirrors the result from regular processing. This finding indicates that the aphasic participants successfully detected the word order violation. The data obtained for the second variable supports the view that the phono-syntactic requirement of cluster building under negation is still operative in agrammatic comprehension, although in a protracted manner.

This interpretation maybe questioned again taking into account that the aphasic RTs in the well-formed conditions do not pattern with the RTs of the normal group. Importantly, the mean RT elicited by the verbs in the well-formed negative imperatives is not shorter than the mean RT elicited by the adverbs in the positive sentence. If the aphasic participants had indeed preserved knowledge of the phono-syntactic properties of clus-

ters consisting of the negative particle and a direct object clitic, they must profit from the structural expectation that the next word is a verb.[5] This argument has to be weighted against the long known findings that in Broca's aphasia, verb retrieval processes are impaired at the single-word level and at the sentence level. (Berndt et al. 1997; Kim and Thompson 2000). Lexical access is a temporal component reflected in the response latencies obtained in self-paced reading tasks (Bartek et al. 2007). Additional evidence for the impact of lexical retrieval difficulties on the RT elicited by the verb in the well-formed negative imperatives is provided by the significant interaction of the factor pronoun type with that of sentence type. Verbs presented after clitic clusters containing reflexive pronouns yielded significantly longer RT than those presented after clusters containing personal pronouns. The presence of a reflexive pronoun triggers argument reduction of the transitive predicate. Changes in argument structure of the predicate, as well as the interpretative component of co-reference establishment between the reflexive pronoun and the subject of the sentence increase the processing load as is reflected in the longer RT.

The second aim of the paper was to explore differences in the processing of personal and direct object clitic in imperative sentences containing transitive verbs. In the task employed, no explicit reference assignment was required. The stimuli used did not provide any additional contextual information on referents. Therefore, in the present experiment, only reflexive pronouns establish a co-reference relation to the virtual addressee of the request by means of syntactic binding. Personal pronouns are prevented from establishing a co-reference relation to the sentential subject on structural grounds and from establishing a co-reference relation to a discourse referent by the lack of contextually available referents. Under these circumstances, the personal pronouns have to be parsed as pure direct object agreement markers.

The control group and the aphasic group show a significant effect of pronoun type on the response latencies of the clitic pronouns. The reflexive clitics elicit slower RT than the personal direct object clitics. Having in mind that syntactically both pronoun types occupy the same position and that the same pattern is obtained in all three sentence types, we can safely conclude that the longer response latencies of the reflexive clitics are associated with an interpretation process which does not take place for the personal clitics. This finding presents new evidence in the scientific discourse concerning different comprehension patterns for reflexive and personal pronouns in agrammatic aphasia and which concerns the assumed sources of such differences: impaired knowledge of syntactic principles and operations or implementation difficulties when a discourse representation has to supplement the syntactic representation for reference establishment. On the one hand, some studies report that agrammatic aphasics exhibit more difficulties in comprehending personal than reflexive pronouns in off-line tests employing truth-value judgement (Grodzingsky et al. 1993; Baauw and Guetos 2003) and in picture-selection tasks (e.g. Ruigendijk et al. 2006). On the other hand, we also find

[5] Recall the template given in (1).

cross-linguistic evidence that aphasic individuals do not experience more difficulties in comprehending personal than reflexive pronouns, both being quantitatively similarly impaired (Edwards and Varlokosta 2007) or similarly preserved (see i.e. Martínez-Ferreiro 2009 and Vasic 2006 for off-line comprehension results from simple transitive sentences).

The results of the present study support the hypothesis that the obtained pattern of clitic processing is based on a slowed-down implementation of narrow syntax knowledge (Burkhardt et al. 2008) in Bulgarian Broca's aphasics. Syntactic binding of reflexive clitics provides for immediate reference establishment. In contrast, personal direct object clitics are parsed as syntactic agreement markers abstracting away from discourse-based reference establishment due to the properties of the employed stimulus sentences. The syntactically triggered interpretation process increased the processing load of reflexive clitics in the normal and in the agrammatic group. Similarly to the unimpaired speakers, the agrammatic group processes personal direct object clitics with greater ease, which is also reflected in the faster integration of the words following personal pronouns in well-formed imperative sentences. The experimental findings thus provide on-line evidence for the influence of differently motivated interpretation processes on the integration of personal and reflexive pronominal clitics into the sentential structure.

6. Conclusion

The aim of the study was twofold. First, we explored normal and agrammatic aphasics' online sensitivity to the phono-syntactic constraints which negation imposes on clitic placement. Second, we explored differences in the incremental integration of personal and reflexive direct object clitics which we assume to be linked to reference establishment costs. We interpret the obtained results to be indicative of the protracted but still effective manner in which the phono-syntactic operations involved in clitic cluster formation are carried out in the tested agrammatic group. By manipulating the contextual availability of referents we show that personal clitics are processed with relative ease as pure syntactic agreement markers by both groups. Taken together, the results from normal and agrammatic comprehension of negative imperatives in Bulgarian demonstrate that the time-course of the availability of prosodic, syntactic and discourse information is decisive for the successful processing of pronominal clitics.

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