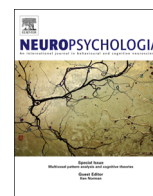




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## Understanding discourse-linked elements in aphasia: A threefold study in Russian

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## ABSTRACT

**Background:** Agrammatic speakers have problems with grammatical encoding and decoding. However, not all syntactic processes are equally problematic: present time reference, *who* questions, and reflexives can be processed by narrow syntax alone and are relatively spared compared to past time reference, *which* questions, and personal pronouns, respectively. The latter need additional access to discourse and information structures to link to their referent outside the clause (Avrutin, 2006). Linguistic processing that requires discourse-linking is difficult for agrammatic individuals: verb morphology with reference to the past is more difficult than with reference to the present (Bastiaanse et al., 2011). The same holds for *which* questions compared to *who* questions and for pronouns compared to reflexives (Avrutin, 2006). These results have been reported independently for different populations in different languages. The current study, for the first time, tested all conditions within the same population.

**Aims:** We had two aims with the current study. First, we wanted to investigate whether discourse-linking is the common denominator of the deficits in time reference, *wh* questions, and object pronouns. Second, we aimed to compare the comprehension of discourse-linked elements in people with agrammatic and fluent aphasia.

**Methods and procedures:** Three sentence-picture-matching tasks were administered to 10 agrammatic, 10 fluent aphasic, and 10 non-brain-damaged Russian speakers (NBDs): (1) the Test for Assessing Reference of Time (TART) for present imperfective (reference to present) and past perfective (reference to past), (2) the Wh Extraction Assessment Tool (WHEAT) for *which* and *who* subject questions, and (3) the Reflexive-Pronoun Test (RePro) for reflexive and pronominal reference.

**Outcomes and results:** NBDs scored at ceiling and significantly higher than the aphasic participants. We found an overall effect of discourse-linking in the TART and WHEAT for the agrammatic speakers, and in all three tests for the fluent speakers. Scores on the RePro were at ceiling.

**Conclusions:** The results are in line with the prediction that problems that individuals with agrammatic and fluent aphasia experience when comprehending sentences that contain verbs with past time reference, *which* question words and pronouns are caused by the fact that these elements involve discourse linking. The effect is not specific to agrammatism, although it may result from different underlying disorders in agrammatic and fluent aphasia.

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## 1. Introduction

### 1.1. Discourse-linking theory and aphasia

Agrammatic aphasic individuals encounter problems with grammatical decoding. However, not all syntactic processing is equally problematic, which becomes apparent in studies that involve the relationship between different linguistic levels, specifically and most notably between narrow syntax and discourse structure. Processing at the level of narrow syntax activates the lexical and syntactic features of linguistic elements and involves computations over these elements. Discourse-linked elements have representation beyond the sentence boundaries, because they have a specific referent, or set of referents, that need to be identified. [Pesetsky \(1987\)](#) argues that for D(iscourse) linked elements a specific connection between their syntactic and discourse representation is required to ensure a correspondence between their grammatical function and eventual interpretation. In other words, processing such elements requires additional operations.

Taking as an example a difference between reflexive elements and pronouns, and also the difference between *Who* and *Which* questions, the following can be stated: For reflexives (e.g. *The woman<sub>i</sub> is washing [herself<sub>i</sub>]*) and *who* questions (e.g. *Who is pushing the man?*) only narrow syntax is needed. The relation between a reflexive and its antecedent can be established within the sentence, by narrow syntax. Likewise, the question word *who* does not refer to a specific referent. However, for object pronouns (e.g. *The woman<sub>i</sub> is washing [her<sub>j</sub>]*) and referential *which*+NP questions (e.g. *Which woman is pushing the man?*) discourse and access to information structure require additional processing apart from narrow syntactic-processing.

It has been shown that agrammatic speakers perform relatively well on sentences with reflexives and on *who* questions (see for example [Avrutin, 2000, 2006](#), and the cited references therein). The scope of narrow syntax is only the sentence; hence, processing at the level of narrow syntax does not require much resource capacity. However, agrammatic speakers' performance on comprehending object pronouns and *which*+NP questions is often impaired. This is consistent with the so-called processing deficit account such as the one by [Caplan, Waters, DeDe, Michaud, and Reddy \(2007\)](#): Agrammatic individuals lack sufficient resources to successfully perform several syntactic operations simultaneously due to limited working-memory capacities.

Recently, the theory on impaired discourse-linking in agrammatic aphasia ([Avrutin, 2006](#)) has been combined with the idea from theoretical linguistics that past tense is discourse-linked ([Zagona, 2003](#)). Tense is a morphological inflection on the verb that provides information about the temporal relation, such as 'simultaneity' or 'precedence,' between the time interval of the event and the time of evaluation set by the context. [Bastiaanse et al. \(2011\)](#) expanded on Zagona's and Avrutin's theory and hypothesized that past time reference is discourse-linked, regardless of the tense used.<sup>1</sup> Agrammatic speakers find it more difficult to produce and comprehend verb forms that refer to the past than verb forms that refer to the non-past, because of their difficulties with discourse linking, which is captured by the Past Discourse Linking Hypothesis (PADILIH; [Bastiaanse et al., 2011; Bastiaanse, 2013](#)). The PADILIH predicts that verb forms with past time reference, such as 'wrote', are impaired in agrammatic aphasia, because they are discourse-linked: in order to interpret a verb

with past time reference, a link has to be made to an event time. Also non-brain-damaged speakers (NBDs) require more resources to process past time reference than to process non-past time reference. Verb forms with non-past time reference,<sup>2</sup> such as 'writes', are relatively spared, because they can be processed by narrow syntax alone.

One of the issues in aphasiology is to what extent comprehension problems are specific to a particular syndrome. In non-brain-damaged people evidence for the linguistic complexity of past time reference comes from studies in which (discourse-related) electrophysiological differences in processing of past and non-past time reference violations have been found, which are related to discourse-processing ([Dragoy, Stowe, Bos, & Bastiaanse, 2012](#)) and not tense ([Bos, Dragoy, Stowe, & Bastiaanse, 2013](#)).

Also for people with fluent aphasia, discourse-linked past time reference requires additional processing. Production studies showed they could still refer to the past; however, they tend to resort to less complex verb forms with non-finite lexical verbs, such as 'has written.' Furthermore, agrammatic speakers are overall less consistent in assigning the correct time reference than fluent aphasic speakers ([Dragoy & Bastiaanse, 2013; Bos & Bastiaanse, 2014](#)). [Cho-Reyes and Thompson \(2012\)](#) found that although syntactic abilities in fluent (anomic) aphasia are largely preserved, more complex forms of verbs and sentences are impaired. Processing of discourse-linked elements by fluent aphasic individuals in other domains has not been sufficiently addressed yet. Only a few studies with fluent aphasic participants reported on the performance in the domain of *who* and *which* questions ([Wimmer, 2010](#)) or in the pronominal domain ([Love, Nicol, Swinney, Hickok, & Zurif, 1998; Ruigendijk & Avrutin, 2003; Grodzinsky, Wexler, Chien, Marakovitz, & Solomon, 1993](#)) and no clear pattern emerged.

We investigated the processing of discourse-linked elements in both agrammatic and fluent aphasia in the domains of time reference, *wh* questions, and pronouns. In the following paragraphs, we review the literature on comprehension of discourse-linked elements in aphasia with a focus on these three domains. Subsequently, we provide the relevant linguistic background on Russian, the language under study, before describing the aims of our experiments.

### 1.2. Previous studies on discourse-linked elements in aphasia

In studies on agrammatism, there is cross-linguistic evidence that supports and further refines the PADILIH. [Bastiaanse et al. \(2011\)](#) report data from the Test for Assessing Reference of Time (TART; [Bastiaanse, Jonkers, & Thompson, 2008](#)), which has a binary choice task for testing comprehension. In languages with a simple verb inflection paradigm (English) and more extensive verb inflection paradigms (Turkish) as well as in a language that uses freestanding grammatical morphemes for time reference (e.g. aspectual adverbs in Chinese), the pattern of reference to the past (through grammatical morphology) being more impaired than reference to the non-past emerged. The TART was also used to test an agrammatic aphasic group of Swahili–English bilinguals. They were more impaired in reference to the past than to the non-past in production and comprehension in both languages.

There are a number of grammaticality judgment studies in which the congruency of the temporal adverb and the verb's time reference was manipulated. No clear pattern has emerged from such studies. [Stavroulaki and Kouvava \(2003\)](#) reported near-ceiling

<sup>1</sup> For example, in English and Dutch one can refer to the past by using the present perfect: a verb form with an auxiliary in present tense that as a whole refers to the past. Such forms were also impaired compared to present time reference ([Bos & Bastiaanse, 2014](#)).

<sup>2</sup> [Aronson \(1977\), Partee \(1973\), and Zagona \(2013\)](#) proposed that future tense should be seen as a sub-class of present tense. They assume it is derived from the present tense via modal and aspectual features. This view is adopted here by distinguishing between past and non-past time reference.

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