Aspects of time: Time reference and aspect production in Russian aphasic speakers

Olga Dragoy a,b,c, *, Roelien Bastiaanse b,d

a Moscow Research Institute of Psychiatry, Russia
b Center for Language and Cognition Groningen (CLCG), University of Groningen, The Netherlands
c National Research University Higher School of Economics, Russia
d University Medical Center Groningen (UMCG), The Netherlands

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A B S T R A C T

Cross-linguistic data suggest that the grammatical categories of tense and aspect are not generally impaired in individuals with aphasia (see Bastiaanse et al., 2011 for a review). Rather, and more specifically, verb forms expressing reference to the past or conveying perfective semantics are more impaired than verb forms expressing reference to the non-past (present or future) or conveying imperfective semantics, both in comprehension and production. The present study used some structural properties of Russian to systematically test the interaction of time reference and aspect in non-fluent and fluent aphasia. The Test for Assessment of Reference of Time (TART; Bastiaanse, Jonkers, & Thompson, 2008; Russian version Dragoy & Bastiaanse, 2010) was used to elicit production of four verb forms in sentence context: past perfective, non-past perfective, past imperfective and non-past imperfective. The results showed that non-past time reference had a general advantage over past time reference, all aspectual forms being collapsed. However, an interaction between time reference and aspect was found: imperfective verbs were better produced in the non-past, whereas production of perfective verbs was better preserved in the past time frame. Non-fluent and fluent aphasic speakers showed largely overlapping performance. These results demonstrated that the advantage of a particular time reference depends on aspectual characteristics of the verb. The performance of both non-fluent and fluent aphasic speakers can be

* Corresponding author. Center of Speech Pathology and Neurorehabilitation, Yauzskaya, 11/6, 109240 Moscow, Russia. Tel.: +7 495 9150585; fax: +7 495 9153947.
E-mail addresses: olgadragoy@gmail.ru, olgadragoy@gmail.com (O. Dragoy).

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explained in terms of prototypical and non-prototypical matches of time reference and aspectual semantics: perfectives primarily refer to completed, past events while imperfectives prototypically describe ongoing, non-past events.

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1. Introduction

1.1. Time reference deficit in aphasia

Tense and aspect morphology has been shown to be particularly vulnerable in individuals with non-fluent, agrammatic aphasia (Burchert, Swoboda-Moll, & De Bleser, 2005; Friedmann & Grodzinsky, 1997; Gavarró & Martínez-Ferreiro, 2007; Kok, Kolk, & Haeverkort, 2006; Wenzlaff & Clahsen, 2004, 2005). However, cross-linguistic data (Abuom, Obler, & Bastiaanse, 2011; Bastiaanse, 2008; Bastiaanse et al., 2011; Faroqi-Shah & Dickey, 2009; Faroqi-Shah & Thompson, 2007; Lee, Milman, & Thompson, 2008; Simonsen & Lind, 2002; Stavrakaki & Kouvava, 2003; Yarbay Duman & Bastiaanse, 2009) suggest that the categories of tense and/or aspect are not impaired in general, but, more specifically, a past time reference deficit is observed in agrammatic individuals. Independent of the expressive inventory of a language, verb forms expressing reference to the past are more impaired in agrammatic comprehension and production than verb forms expressing reference to the present or future. The two latter verb forms are, from a typological point of view, often regarded as one single non-past category (Comrie, 1985).

As recently proposed in the Past Discourse Linking Hypothesis (PADILIH; Bastiaanse et al., 2011), a specific past time reference deficit may be caused by its discourse-related nature: reference to the past, but not to the present or future, requires a relation established between speech time and an earlier event, which is called ‘discourse-linking’. Processing information at the level of discourse syntax has proven to be problematic for agrammatic individuals and for children. It has been shown, for example, that reflexives and who-questions that both need no processing at the level of discourse syntax but can be processed by ‘narrow syntax’ are better preserved in agrammatic individuals and earlier acquired by children than anaphoric pronouns and which-questions, respectively (Avrutin, 2006; for reflexives vs. anaphora, see Grodzinsky, Wexler, Chien, Marakovitz, & Solomon, 1993; for wh-questions, see Hickok & Avrutin, 1995).

Although tense is among the most common linguistic devices used to express time reference, in many languages time reference highly interacts with the category of aspect. Grammatical aspect is traditionally regarded as a way of viewing the internal temporal constituency of a situation: perfective verb forms describe the situation as a whole, without separate phases, while imperfective verb forms relate to the internal structure of the situation (Comrie, 1976). Interestingly, available aphasiological data show that not only is past time reference related to worse performance than non-past time reference, but perfective aspect is more impaired than imperfective aspect in individuals with agrammatic aphasia (Nanousi, Masterson, Druks, & Atkinson, 2006; Stavrakaki & Kouvava, 2003). These results confirm that irrespective of the specific category conveying the meaning of event time (be it tense or aspect) and the way it is expressed in a language (inflections or auxiliaries, bound or free-standing morphemes), grammatical expressions for past and/or event completeness are impaired in aphasia.

The present study focuses on further exploring the time reference deficit in aphasic speakers. The structural characteristics of Russian allow for testing of whether the past time reference deficit (as suggested by the PADILIH) is universal in aphasia or whether it depends on other characteristics of the verb, such as aspect. In addition, due to its close relationship with lexical aspect (also known as ‘actionality’ or ‘Aktionsart’), Russian grammatical aspect has been the topic of numerous theoretical debates, but never of an experimental study in individuals with aphasia.

1.2. Time reference and aspect in Russian

Time reference in Russian is mostly expressed through tense inflections. Except for the analytic form of Future Imperfective, Russian distinguishes inflected forms of past, present, and future. Past and
forms of one and the same word. Rather, they have different entries in the dictionary; that is, they are obeschat imperfective: razrez dat perfective counterpart: by means of preform perfectives from imperfectives and vice versa. Perfective verbs can be derived from imperfectives expressed through verb morphology (Zaliznyak & Shmelev, 2000). There is no unique way, however, to subject. Bastiaanse, Rispens, Ruigendijk, Juncos Rabadan, and Thompson (2002) showed that in German, for example, it is also visible on the determiner. If a tenseless verb form is used (a bare gerund writing or a bare participle written), no nominative case can be assigned to the grammatical subject. Bastiaanse, Rispens, Ruigendijk, Juncos Rabadan, and Thompson (2002) showed that in German agrammatic speech, there is a strong relation between the production of tensed verbs and determiners: when a tensed verb is used, the subject determiner is produced, when a non-tensed verb is used, the determiner is omitted. This shows the grammatical function of tense.

In turn, information about the internal constituency of the event is expressed through aspect (Comrie, 1976; Plungian, 2000). As in many languages, Russian distinguishes between perfective aspect (corresponding to an external viewpoint on the situation with highlighted boundaries) and imperfective aspect (an internal viewpoint focusing on a moment other than initial or final). Both are expressed through verb morphology (Zaliznyak & Shmelev, 2000). There is no unique way, however, to form perfectives from imperfectives and vice versa. Perfective verbs can be derived from imperfectives by means of prefixation: delat’ > sdelat’ (to do); root change: poslat’ > poslat’ (to send); or stress change razrezat’ > razrezat’ (to cut). Suffixation is used when an imperfective verb is being derived from its perfective counterpart: dat’ > davat’ (to give). A number of verbs are used as both perfective and imperfective: obeschat’ (to promise).

Russian aspect is different from standard grammatical aspect in several respects. Russian aspect is expressed through derivational morphology. Consequently, aspectual counterparts are not inflected forms of one and the same word. Rather, they have different entries in the dictionary; that is, they are considered to be different lexical items. Apart from that, grammatical aspect in Russian conveys a viewpoint on the situation and has a direct relationship with lexical aspect, which reflects the temporal and causal structure of the situation (e.g., stative, telic, punctual, etc.; Bondarko, 1983; Johanson, 2000). Although lexical aspect as a part of verb semantics can be found in many languages, it has been argued that in Russian it restricts grammatical marking, influencing both distribution and meaning of aspectual markers. For example, the choice of aspectual prefixes is motivated by semantic characteristics of the verb stem (Tatevosov, 2002). Thus, theoretical perspective emphasizes the lexical character of Russian aspect.

Time reference and aspect interact in Russian, as shown in Table 1. Reference to the past and future can be used in both perfective and imperfective verbs, but only imperfective verbs can be used to express reference to the present. Past forms are generally formed by adding the suffix –I– together with the inflection for gender and number to the infinitive verb stem. For example, pisa-I represents the Past Imperfect, masculine, third-person singular (he was writing), while napisa-I-a represents the Past Perfective, feminine, third-person singular (she wrote). Reference to the present can only be expressed by imperfective verbs and is achieved by adding an inflection for person and number to the present stem: pish-et represents the Present Imperfect, third person singular (s/he is writing). Reference to the future is expressed through the synthetic Future Perfective (for perfective verbs) or the analytical Future Imperfective (for imperfective verbs). Future Perfective, although referring to the future, is technically formed in the same way as Present Imperfect, but uses perfective verbs: napish- et for the Future Perfective, third person singular (s/he will write). Future Imperfective is formed analytically by combining a present form of the verb byt’ (to be) with an Infinitive Imperfect: bud-et pisat’ represents the Future Imperfect, third person singular (s/he will be writing).

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<tr>
<th>Time</th>
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<th>Past</th>
<th>Present</th>
<th>Future</th>
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<tbody>
<tr>
<td></td>
<td>Imperfective</td>
<td>pisa-I (was writing)</td>
<td>pish-et (is writing)</td>
<td>budet pisat’ (will be writing)</td>
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<td></td>
<td>Perfective</td>
<td>napisa-I (wrote)</td>
<td></td>
<td>napish- et (will write)</td>
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An interesting perspective on time reference (as expressed through tense) and aspect interaction in Russian has been provided by language acquisition data. Russian children strongly prefer to use perfectives to refer to the past, and imperfectives to refer to the present (Gagarina, 2004). In addition, it was shown that children do not acquire Russian aspectual oppositions on a rule basis; rather, the process is lexically guided (Gagarina, 2004). Specifically, grammatical aspect acquisition is dependent upon children’s developing ability to differentiate between situational semantics, or lexical aspect (Stoll, 1998). These experimental findings suggest that grammatical aspect is built upon lexical aspect in Russian, and that Russian aspect’s lexical nature semantically guides time reference assignment, at least in the still-developing linguistic systems of children.

The relationship between aspect and time reference in children has been explained from both cross-linguistic and cognitive perspectives. Situations with defined boundaries (e.g., punctual events) expressed through perfective verbs naturally refer to the past, and situations focused on internal structure (e.g., on-going activities) as expressed through imperfective verbs refer to the present time frame. The same correlation between the distinction of perfective/imperfective and past/non-past time reference is often observed across languages (Dahl, 1985). Thus, Russian children’s use of such prototypical matches of time reference and aspect may consume less resources and become a preferred strategy, in line with the suggestion of Avrutin (2000, 2006).

1.3. Goals of the study

Based on the available aphasiological literature on this topic (Bastiaanse, 2008; Bastiaanse et al., 2011; Faroqi-Shah & Dickey, 2009; Faroqi-Shah & Thompson, 2007; Lee et al., 2008; Simonsen & Lind, 2002; Stavrakaki & Kouvava, 2003; Yarbay Duman & Bastiaanse, 2009), we hypothesized that Russian aphasic speakers would show the same specific past time reference deficit as aphasic speakers of previously studies languages. This pattern of performance is predicted by the PADILIH (Bastiaanse et al., 2011) for agrammatic speakers of any language. For the present study, the ability of Russian individuals with aphasia to express past and non-past time reference was examined. Inflectional verb forms (two with reference to the past and two with reference to the non-past (present and future) were tested to control the number of words produced.

Russian is different from all other languages previously used to study the problems of time reference, because of the aforementioned interaction with aspect. This study, therefore, addresses the questions of how aspeccal characteristics of verbs are realized in aphasic speech and how they influence time reference production. Half of the tested verb forms were imperfective (Past Imperfective and Present Imperfective), and half were perfective (Past Perfective and Future Perfective). This 2 × 2 design, illustrated in Table 2, allows us to examine the interaction of time reference and aspect in aphasic speakers.

We propose two alternative hypotheses regarding Russian aphasic speakers’ production of aspec- tual verb forms. Both integrate the PADILIH (Bastiaanse et al., 2011) with respect to the time reference effect (past forms are more impaired than non-past forms), but they differ regarding the influence of aspect. The first hypothesis is based on findings from Greek (Nanousi et al., 2006), which showed that production of perfective verbs is more impaired than imperfective verb production. If the same holds true for Russian, it should result in a hierarchy of difficulties, with Past Perfective being the most problematic form. Past Imperfective and Future Perfective should be less problematic (which of the two forms is better preserved depends on the size of the time reference and aspect effects), and Present Imperfective is expected to be the form that is most spared. Thus, the first hypothesis is that in Russian the effects of time reference and aspect are additive: past time reference and perfective aspect worsen performance of aphasic speakers, while non-past time reference and imperfective aspect improve it.

<table>
<thead>
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<th>Table 2</th>
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<td>The four Russian verb forms that have been tested, illustrated with an example of the verb pisat’ (to write).</td>
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<th>Aspect</th>
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<tr>
<td></td>
<td>Past</td>
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<td>pisat’</td>
<td>pisa-l (was writing)</td>
<td>napisa-l (wrote)</td>
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<td>Non-past</td>
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<tr>
<td>pisat’</td>
<td>pish-et (is writing)</td>
<td>napish-et (will write)</td>
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The alternative hypothesis takes into account a difference between aspect in Greek and Russian and the acquisition data of Gagarina (2004). Greek aspect is an inflectional grammatical category (Tsapkin, Jarema, & Kehayia, 2002; Xydopoulos, 1996), and is therefore expected to be impaired in aphasic speakers similarly to any inflectional grammatical category (although not necessarily to the same extent). In contrast, Russian aspect is expressed through derivational morphology and is interrelated with lexical aspect (Hamburger, 1984; Tatevosov, 2002; Zaliznyak & Shmelev, 2000). Similarities between the linguistic performance of children and individuals with aphasia suggest that the same strategies are used in the two populations (Avrutin, 2000; Grodzinsky 1990; Jakobson, 1941). Following this reasoning, one can expect that, similarly to children, Russian aphasic speakers will encounter problems with integrating information about lexical aspect and morphosyntactic tense. Yarbay Duman, Altinok, Özgirgin, and Bastiaanse (2011) argued that the deficits in comprehension of sentences with derived word order are not simply due to word order problems. In their study, Turkish sentences in which the agent and theme were not in their base position were difficult for agrammatic individuals, but sentences non-canonical case marking were difficult as well, even when the agent preceded the theme. On the basis of these data, Yarbay Duman et al. (2011) formulated the Integration Problem Hypothesis, stating that it is hard for individuals with agrammatic aphasia to integrate information from different linguistic levels. For the present study, this hypothesis predicts that integrating lexical information about aspect and syntactic information about tense will be hard for agrammatic, and may be for all aphasic individuals. In that case, they may use revert to the simplest matches: perfectives to refer to the past, and imperfectives to refer to the non-past. This prediction limits the PADILIH to imperfective verbs: These are expected to be better produced in the non-past time frame. However, perfective verbs should be better produced in the past time frame. Thus, according to the alternative hypothesis, time reference and aspect interact in Russian: non-past time reference is advantageous only for imperfective verbs; in contrast, for perfective verbs, past time reference is less problematic.

A final goal of the study was to compare the performance of non-fluent and fluent aphasic speakers. Despite the hypothesis of a specific past time reference deficit (PADILIH; Bastiaanse et al., 2011) was originally formulated for agrammatic (non-fluent) speakers, Bastiaanse (2011) showed that fluent aphasic speakers have problems with finite verbs in spontaneous speech: they show a reduced diversity of lexical verbs and use more highly-frequent verbs than do non-brain-damaged speakers. However, this was found to be solely caused by a lower diversity and a higher frequency of the finite verbs, whereas the diversity and frequency of non-finite verbs (infinitives and participles) was normal. These problems with finite verbs suggest that a specific past time reference deficit may be expected in fluent aphasic speakers too. In another Dutch study, Jonkers and Bruin (2009) demonstrated that fluent speakers with Wernicke’s aphasia experience more problems when producing past tense than when producing present tense. It is not known, however, whether non-fluent and fluent aphasic speakers perform similarly regarding aspeceual characteristics of the verb and interaction of time and aspect.

2. Method

2.1. Participants

Seven non-fluent aphasic speakers (mean age 40 years; 4 female) and seven fluent aphasic speakers (mean age 58 years; 2 female), all native speakers of Russian, were tested. The aphasia type for each participant was established using Luria’s Neuropsychological Investigation (Luria, 1966). The diagnosis for all non-fluent participants was efferent motor aphasia which was accompanied by afferent motor aphasia and/or dynamic aphasia in most cases. These participants showed classic agrammatic performance: non-fluent, effortful and telegraphic speech production, and relatively intact comprehension. The diagnosis for all fluent aphasic participants was sensory and acoustic-mnestic aphasias with an exception of one individual who was diagnosed with sensory and conduction aphasias. All fluent aphasic participants demonstrated fluent speech output with verbal and phonemic paraphasias, word finding difficulties and impaired comprehension. All of the aphasic speakers were 6–70 months post-onset of a left hemisphere stroke, right-handed, had normal (or corrected to normal) hearing and vision, and had at least a high school education. None of them suffered from apraxia of speech (to an extent that it influenced the test results), developmental speech or language disorders, or prior neurological disease.
Seven non-brain-damaged speakers (mean age 50 years; 4 female) served as control participants. All were native speakers of Russian, right-handed, with normal (or corrected to normal) hearing and vision, and at least a high school education. None of them had any language or speech impairment history. Individual characteristics of all participants (aphasic and non-brain-damaged) are given in Appendix 1.

2.2. Materials

The Russian version of the Test for Assessment of Reference of Time (TART; Bastiaanse et al., 2008; Russian version Dragoy & Bastiaanse, 2010) was used with the aphasic and non-brain-damaged participants to elicit production of four different verb forms in a sentence context: Present Imperfect, Past Imperfect, Future Perfective and Past Perfective. The materials consisted of pairs of photographs representing either (a) two ongoing action performances, (b) two completed actions, and (c) two intentions to perform an action. Above each photograph, a target verb was printed in its infinitive, unmarked form, as would be found in any Russian dictionary. Twenty aspectual verb pairs were used in four experimental conditions. Twenty imperfective verbs with corresponding photographs related to a present or past action were used to elicit Present Imperfective and Past Imperfective, respectively. Twenty perfective verb pairs, corresponding with photographs depicting a past or future action, were used to elicit the Future Perfective and Past Perfective. Sixty fillers were used with the same verbs and corresponding pictures to elicit periphrastic forms with reference to the future: an auxiliary + Infinitive Imperfect/Infinite Perfective (hochet risovat’ – wants to draw_{imp}; hochet narisovat’ – wants to draw_{prf}; budet risovat’ – will draw_{imp}).

All verbs were transitive, and all photographs showed a human agent/subject and an inanimate theme/object. Every verb in each form occurred twice in the test – once in the prime sentence and once in the target. The full list of the aspectual pairs with English translations can be found in Appendix 2.

2.3. Procedure

Participants were tested individually. A pair of colored photographs with a verb printed above each picture was presented to the participant. The experimenter read the verbs and named the persons and objects in the photographs to ensure proper recognition. The experimenter then spoke a sentence pertaining to the picture on the left side, and invited the participant to form a similar sentence for the picture on the right side. For example, for Fig. 1, the experimenter produced the prime Now the man is peeling an apple, and the participant was expected to produce Now the man is eating an apple.

![Fig. 1](image_url). A pair of photographs with the verbs to peel and to eat in Russian used for eliciting the sentence Now the man is eating an apple.
second photograph. When asked by a participant for repetition, the experimenter repeated the prime sentence.

Temporal adverbs were used to elicit different verb forms: *sejchas* (now) for Present Imperfect, *nedavno* (not long ago) and *tol’ko chto* (just before) for Past Imperfective and Past Perfective, respectively, *skoro* (soon) for Future Perfective. Filler verb clusters were elicited with the time neutral adverb *zdes’* (here).

Seven practice trials using non-test stimuli preceded the experiment to explain to the participant what s/he was expected to do. If the participant gave the correct sentence, it was said that this was the expected answer. In case of an error, the participant was corrected and it was explained why this was not the expected answer. After the practice trials no feedback was given. Eighty experimental (twenty in each condition) and sixty filler trials were presented in two sessions that were equal in the number of trials included, with a break of a few days between the sessions for aphasic speakers and a coffee break for non-brain-damaged participants. The order of the trials was pseudo-randomized in such a way that the same verb and form never occurred in two consecutive trials. The order of the sessions varied across the participants. Each session lasted about 30 min for aphasic speakers and 10 min for non-brain-damaged participants.

2.4. Scoring

Both quantitative and qualitative analyses were performed. For the quantitative scoring, correct and incorrect responses were tallied. A response was considered to be correct if it contained the target verb in the target form. Self-corrections were allowed. If an adverb or other sentence constituent (such as subject or object) was not produced, it was not counted as an error, since such elliptical constructions are grammatical in Russian. Agreement errors and plausible lexical substitutions were not regarded as incorrect responses either, because the inflections produced still made it possible to unambiguously determine time reference and aspectual characteristics of the verb.

For the qualitative analysis, the error patterns in both aphasic groups were distinguished. Overall, participants used seven verb forms to respond to the target: Infinitive Imperfect, Infinitive Perfective (either bare infinitives or infinitives within verb clusters), Present Imperfective, Past Imperfective, Past Perfective, Future Imperfective, and Future Perfective. Since no responses involved a verb being absent or replaced by a noun, these seven verb forms cover all answers given by the participants. In each trial only one verb form was considered to be the target. For each target verb form the number of substitutions with one of the other six verb forms was counted and the resulting substitution patterns were analyzed.

3. Results

3.1. Quantitative analysis

Non-brain-damaged participants performed significantly better than both non-fluent (*z = 8.78, p = .001*) and fluent aphasic speakers (*z = 8.56, p = .001*). The mean accuracy score of the non-brain-damaged participants was 98% with no difference across experimental conditions. As they performed at ceiling, their data will further be ignored, and the analysis will focus on errors made by the aphasic speakers.

Aphasic speakers performed worse than non-brain-damaged participants in all conditions and showed differences across conditions. The results of both aphasic groups are illustrated in Fig. 2 (the individual scores are given in Appendix 3).

As can be seen from Fig. 2, the overall performance of fluent aphasic speakers was slightly better than the performance of non-fluent speakers (61% vs. 59% correct responses overall). This difference, however, did not reach statistical significance. There was also no significant interaction between the

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1 Statistical analysis was performed using mixed-effect modeling with crossed random effects for subjects and items in R, an open-source programming language and environment (R development core team, 2005).
factor of aphasia type and other factors (time reference or aspect), which suggests that non-fluent and fluent aphasic speakers performed similarly from a quantitative point of view. Thus, the effects reported below equally characterize both aphasic groups.

A significant main effect of time reference ($z = 2.66, p = .01$), but no main effect of aspect ($z = 2.66, p = .01$) were found. However, there was a significant interaction of time reference and aspect ($z = 0.44, p = .66$). Pairwise comparisons revealed that the effect of time reference was significant, but in opposite directions for imperfective ($z = 7.78, p = .001$) and perfective verbs ($z = -4.06, p = .001$). Reference to the non-past in general (with perfective and imperfective verbs collapsed) was better produced than reference to the past (64% vs. 56%). Errors in production of imperfective and perfective verbs in general (with different time frames collapsed) were equally frequent (61% vs. 60%). Finally, the interaction between time reference and aspect is represented by the pattern of the two aphasic groups shown in Fig. 1. Reference to the non-past is better preserved than reference to the past, but for imperfective verbs only. In contrast, for perfective verbs, reference to the past was produced better than reference to the non-past.

### 3.2. Qualitative analysis

Although the quantitative analysis revealed a uniform pattern of performance in non-fluent and fluent aphasic speakers, we hypothesized that the nature of errors could differ in the two groups. The qualitative analysis focused, therefore, on substitutions of target verb forms.

Overall, nine verb forms were produced in the test. Four of them were targets in the experimental trials (Present Imperfect, Past Imperfect, Future Perfective, Past Perfective). Three were periphrastic forms with reference to the future: targets in fillers (an auxiliary other than ‘to be’ + Infinitive Imperfective, as in *hochet risovat* – wants to *drawimp*); an auxiliary other than ‘to be’ + Infinitive Perfective, as in *hochet narisovat* – wants to *drawprf*); and the Future Imperfective formed by the auxiliary ‘to be’ + Infinitive Imperfective, as in *budet risovat* – *will drawimp*. Two other types of responses were the Infinitive Imperfective or Infinitive Perfective (*risovat*/*narisovat*) which have no specific time reference without an auxiliary. Table 3 shows the percentages of substitutions for each of four target verb forms.

In the Present Imperfective and Past Perfective, the conditions with the fewest errors, the two aphasic groups performed similarly. Present Imperfective was predominantly substituted with non-past imperfective forms (Future Imperfective and/or the cluster [auxiliary + Infinitive Imperfect], both with reference to the future) or neutral in respect of time reference Infinitive Imperfect. In addition, non-fluent speakers substituted Present Imperfective with Past Imperfective, showing a greater tendency to change the target non-past time frame into the past, compared to fluent aphasic
The two groups substituted Past Perfective with non-past but perfective forms (Future Perfective and the cluster [auxiliary + Infinitive Perfect], both with reference to the future). Thus, in the least problematic conditions, non-fluent and fluent aphasic speakers did not change aspectual characteristics of the target form, kept non-past time reference of the present target form, and switched to non-past time reference in case of the past target form. This pattern can be extended for non-fluent speakers who also produce past time reference for non-past.

In the more problematic Past Imperfective and Future Perfective conditions, fluent and non-fluent speakers showed largely overlapping performance as well. Both groups substituted Past Imperfective either with the non-past form of Present Imperfect, or with Past Perfective, thus retaining either aspectual characteristics of the target or its time reference, with the former strategy prevailing. Future Perfective was often substituted with Past Perfective in the two aphasic groups, again showing that aspect of the produced form tended to be the same as in the target. However, non-fluent and fluent aphasic speakers differed with respect to the proportion of such substitutions and other errors they made for Future Perfective. Non-fluent speakers also often produced Infinitive Perfective in place of Future Perfective, keeping the aspect of the target, but not referring to any time frame. In sum, Future Perfective and Past Imperfective conditions were related to specific substitution patterns. In contrast to the less problematic conditions, past time reference of Future Perfective was often replaced by reference to the past, with aspectual characteristics of the target form retained. The latter was not always the case for Past Imperfect: aphasic speakers may keep aspect the same when switching from past to non-past and producing Present Imperfect, but they also change aspect to refer to the same time frame which resulted in Past Perfective. As in the less problematic conditions, non-fluent speakers made more substitutions of the target non-past time frame with the past, compared to fluent aphasic speakers.

### 4. Discussion

The study pursued several aims. Firstly, we tested the PADILIH (Bastiaanse et al., 2011) which predicted that reference to the past would be particularly vulnerable in Russian non-fluent aphasic speakers as compared with reference to the non-past. Secondly, because reference to a time frame is closely related to the category of aspect in Russian, the study addressed the questions of how aspectual
characteristics of the verb influence aphasic speech production and how they interact with time reference. The final aim of the study was to test both non-fluent and fluent aphasic speakers to reveal if they show similar or different patterns in processing time reference and aspect.

4.1. Past time reference deficit

The results confirmed that in Russian, as in previously studied languages (Bastiaanse, 2008; Bastiaanse et al., 2011; Faroqi-Shah & Dickey, 2009; Faroqi-Shah & Thompson, 2007; Lee et al., 2008; Simonsen & Lind, 2002; Stavrakaki & Kouvava, 2003; Yarbay Duman & Bastiaanse, 2009), individuals with aphasia show specific past time reference impairment. With accuracy values collapsed for different aspectual forms, quantitative analysis revealed a general advantage of non-past over past reference production (64% vs. 56% correct). Major substitution error patterns confirm the relative ease of non-past reference production as well. Verbs forms that were less prone to errors (Present Imperfective and Past Perfective) were predominantly substituted with non-past forms, namely, with clusters [auxiliary + infinitive] with reference to the future. In the more problematic past condition (Past Imperfect), the prevailing strategy again was to refer to the non-past time frame, resulting in Present Imperfect. The same pattern held for another condition with a larger number of errors (Future Perfect), but in individuals with fluent aphasia only: they substituted the target with other non-past forms constituting clusters [auxiliary + infinitive Perfective] with reference to the future.

Interestingly, a majority of non-past substitutions resulted in the production of bare infinitives or verb forms referring to the future. Present Imperfective forms were replaced with Future Imperfect, the cluster [auxiliary + Infinitive Imperfective] or bare Infinitive Imperfect forms. Similarly, Past Perfective forms were often replaced with the cluster [auxiliary + Perfective Imperfective]. For Future Perfect, again the majority of substitutions were [auxiliary + Infinitive Perfective] in the fluent aphasic group, and a large number of Future Perfective substitutions resulted in bare Infinitive Perfective forms in the non-fluent group. The fact that not only verb forms with reference to the future, but also bare infinitives were used by aphasic speakers to facilitate production of the target forms, suggests that bare infinitive forms play a critical role in the observed substitution pattern. The infinitive is the least marked verb form in Russian. Taking into account the general deficiency of production of inflectional morphology in individuals with aphasia (Burchert et al., 2005; Friedmann & Grodzinsky, 1997; Gavarró & Martínez-Ferreiro, 2007; Kok et al., 2006; Wenzlaff & Clahsen, 2004, 2005), the aphasic speakers in the current study adhered to the strategy of producing infinitives instead of inflected verb forms, although the result is a longer verbal cluster. An alternative explanation for their substitutions with future verb forms – the relative ease of future reference production – finds little support in the literature. On the contrary, comprehension of future time reference in individuals with aphasia was reported to be more impaired than present time reference (Bastiaanse et al., 2011; Faroqi-Shah & Dickey, 2009). Thus, we think that the substitutions with future verb forms are due to the fact that they contain the least morphologically marked form: the infinitive.

Although the findings of the current study support the PADILIH (Bastiaanse et al., 2011) and the idea of specific past time reference difficulties in aphasic speakers in general, they force us to extend the hypothesis because it cannot fully account for the data from languages in which aspect plays such a crucial role. Despite a strategy to substitute past verb forms with forms referring to the non-past, the opposite pattern was also observed for one particular target form: Future Perfect. When this form was the target, non-fluent aphasic speakers frequently switched from non-past to past, thus producing Past Perfective. Fluent aphasic speakers did that too, although to a lesser degree. This pattern, as well as the strategy to retain the target time reference for Past Imperfect, while changing the aspect of the target verb, can be explained by a time reference–aspect interaction.

4.2. Aspect makes a difference

In contrast to Nanousi et al. (2006) and Stavrakaki and Kouvava (2003), the Russian aphasic speakers who participated in the current study were not severely impaired in the production of perfective verbs in general as compared with imperfective verbs (61% vs. 60% correct respectively). The predicted hierarchy of difficulties, with Past Perfective being the most problematic form, Past
Imperfective and Future Perfective being less problematic, and Present Imperfective being the most spared form, was not found either. This implies that perfectiveness per se does not worsen the performance of Russian aphasic speakers, and the first hypothesis about additive value of time reference and aspect outlined in the Introduction should be discarded.

According to the alternative hypothesis, time reference and aspect interact in Russian; non-past time reference is better preserved for imperfective verbs, while past time reference is better preserved for perfective. Indeed, quantitative analysis revealed a significant interaction between time reference and aspect. Despite the already discussed general advantage of non-past over past reference production, this pattern was observed for imperfective verbs only. In contrast, for perfective verbs reference to the past was produced with higher accuracy than reference to the non-past, although the difference between the scores was not as large as it was for imperfective verbs. It seems as though individuals with aphasia have problems integrating information of syntactic tense with information of lexical aspect, as predicted by the Integration Problem Hypothesis of Yarbay Duman et al. (2011). The observed dissociation between imperfective and perfective verbs may be regarded as a logical consequence of aspectual semantics. Across languages, there is a strong tendency for perfective categories to be restricted to past time reference (Dahl, 1985). That is, perfective verbs denoting events completed within particular temporal boundaries are prototypically used to refer to the past. Languages differ in the extent of this restriction. In some languages, perfective may be interpreted as ‘only past’, while in others it would only be interpreted as ‘only non-present’. Russian is an example of the latter category: perfective verbs cannot refer to the present, but both reference to the past and reference to the future are grammatical. However, the prototypical use of perfectives remains the same: they primarily refer to the past. The same logic holds for imperfectives and their prototypical reference to the non-past, and in particular to present, ongoing events. Reference to the past expressed with an imperfective verb may be grammatical in a language, but not prototypical.

Such prototypical use of perfectives and imperfectives seems to play the central role in the observed aphasic deficit. Aphasic speakers made significantly fewer errors when producing prototypical exemplars (Present Imperfective and Past Perfective). When the non-prototypical, although grammatical, use was required (Past Imperfective and Future Perfective), the number of errors increased. The substitution patterns were even more revealing. When being substituted, prototypical Present Imperfective and Past Perfective were mainly replaced with non-past forms following a non-past time reference advantage. Critically, in Past Imperfective and Future Perfective aspectual characteristics are in conflict with time reference in the sense of their prototypical match. Thus, aphasic speakers, instead of producing those non-prototypical combinations of time reference and aspect, tried to adapt to the conflict. There are two strategic possibilities: change the time reference, or change the aspect. And, indeed, Past Imperfective was often substituted either with Present Imperfective (time reference adjustment) or Past Perfective (aspect adjustment). The fact that Future Perfective was often substituted with Past Perfective, but not by Future or Present Imperfective (using the time adjustment strategy only), suggests that Russian aphasic individuals often use aspectual semantics to assign time reference.

Stability of aspectual characteristics of the verb in aphasic production finds extensive support in other substitution patterns. Similarly to Future Perfect, Present Imperfective and Past Perfective were predominantly substituted with forms differing regarding time reference, but with the same aspect as the target form – imperfectives and perfectives correspondingly. This is strong evidence for aspect being more stable than time reference in Russian aphasic individuals: they consistently retain aspectual characteristics of the target verb form and even use aspect as a determiner of time frame to produce. A possible reason for that can be the resistance to change a lexical item. As mentioned in the Introduction, Russian aspectual counterparts have different lexical entries in the dictionary. In contrast to time reference shifts when tense inflectional morphology has to be changed, shifting to a different lexical item might be more effortful. Interestingly though, lexical shifts are not impossible in principle and do occur when temporal semantics strongly suggests a particular aspect, as the substitutions of Past Imperfect with Past Perfect demonstrate.

Hence, we conclude that it is not solely time reference, but rather the interaction between time reference and aspect which influences production of tensed verb forms in Russian aphasia. When only prototypical matches of time reference and aspect (Present Imperfective and Past Perfective) are
contrasted, the non-past advantage accounts for fewer errors in the Present Imperfective condition. Similarly, when only non-prototypical matches of time reference and aspect (Past Imperfective and Future Perfective) are contrasted, the non-past Future Perfective form is less error prone. However, error distribution within imperfective and perfective verb forms is governed by their aspectual characteristics: imperfectives are better produced in the non-past time frame, while perfectives co-occur with past time reference.

The same strong association between past and perfectives on the one hand, and non-past and imperfectives on the other, has been reported with respect to Russian aspect acquisition (Gagarina, 2004). Taking into account a lexically guided manner of learning aspectual oppositions in Russian (Stoll, 1998), children’s preference to use perfectives for the past and imperfectives for the non-past reflects the crucial role of verb semantics for the choice of a prototypical time reference match. Following Avrutin (2000), we consider this a strategy applied when processing resources are limited or cannot be attributed to a relevant task in an optimal way, a likely scenario in children whose linguistic system is not fully developed. Aphasic individuals may experience a similar resource limitation due to brain damage, resulting in their reliance on the same strategy to link imperfective and perfective verbs to the non-past and past respectively. That is, the time reference–aspect interaction found in the current study provides support for the idea that there is an identical, but reversed order of language development and language dissolution (Avrutin, 2000; Grodzinsky 1990; Jakobson, 1941). The latter also explains the stability of aspect processing in aphasic production. In children, the acquisition of situational semantics (which is directly related to lexical aspect) precedes the acquisition of aspectual (Stoll, 1998) and tense markers (Gagarina, 2004). If the order is reversed in language dissolution, aspect in general and lexical aspect in particular can be more resistant to impairment in Russian individuals with aphasia.

Although debates about the nature of Russian aspect (to what extent it is a grammatical or a lexical category) are still going, the available data suggest that in populations with atypical language processing (children acquiring language, individuals with aphasia) aspectual oppositions are treated as predominantly lexical and guide grammatical choice. Tense inflections are, therefore, chosen on the basis of verb semantics, which includes aspectual information. That constitutes a possible explanation for the differences between the Russian and Greek (Nanousi et al., 2006; Stavrakaki & Kouvava, 2003) results. In contrast to Russian aspect, which is related to derivational morphology and is more lexical in nature (at least in children and individuals with aphasia), Greek aspect is a grammatical category expressed through inflection (Tsapkini et al., 2002; Xydopoulos, 1996). While lexical semantics are more resistant under limited processing resources, this may not be the case for pure grammatical categories. Indeed, Greek grammatical aspect shows a parallel with another inflectional category: tense. Deficiency of past tense couples with deficiency of perfective aspect, in contrast to advantage of reference to the present and imperfective aspect. Instead, aspect and tense dissociate in Russian. Thus, Russian and Greek show two different patterns of time reference–aspect interaction caused by the nature of the category of aspect in the two languages.

The method used in the current study focused on aphasic behavior and resulted in data about performance accuracy. Such a method may not be sufficiently sensitive to test whether the same strategy guides performance of healthy adult speakers of Russian, who all performed at ceiling. Further research using reaction time or electrophysiological measurements will reveal more about normal processing of time reference. If a processing advantage is found for the prototypical time reference–aspect match, this will be strong experimental evidence for the lexical nature of Russian aspect in general, not only in children acquiring their first language and adults with aphasia.

4.3. Time reference and aphasia syndromes

All the reasoning provided above can account for the behavior of both aphasic groups to a major extent. Non-fluent and fluent aphasic speakers showed quite similar quantitative patterns of performance. Also, the two groups used very similar substitution strategies. In six out of nine major substitution types (marked with gray color in Table 3), whenever a verb form was used as a dominant substitution in the non-fluent group, it was also dominant in the fluent aphasic group.

The analysis of the remaining three substitution types, however, reveals that fluent and non-fluent aphasic speakers still show differences in time reference (but not aspect) production. Fluent aphasic
speakers developed the strategy of retaining non-past time reference of the target verb form, thus consistently replacing Present Imperfective and Future Perfective with verb clusters referring to the future. In contrast, non-fluent speakers showed greater proneness to change the target non-past time frame into past: they substituted Present Imperfective with Past Imperfective as well as with non-past verb forms; and producing Past Perfective in place of Future Perfective was the dominant substitution strategy. In addition, non-fluent speakers produced infinitives without a particular time reference more often than fluent aphasic speakers did. These data suggest that the process of assigning time reference in general is more impaired in non-fluent than in fluent aphasia. Although the overall performance of non-fluent speakers follows the advantage of non-past time reference over past (confirmed by quantitative analysis and major patterns of substitution errors), assigning temporal relations is less stable than it is for fluent aphasic speakers. This may be the cause of the observed deviations from the main strategy which fluent aphasic speakers followed consistently.

The observed similarities between the performance of non-fluent and fluent aphasic speakers are in line with findings of Jonkers and Bruin (2009) and Wieczorek, Huber, and Darkow (2011), who suggest that the ability to provide time reference by verb forms is not only compromised under the condition of left frontal brain damage (often causing non-fluent aphasia). And although information about lesion sites of aphasic speakers who participated in the present study is not available, this claim is not based solely on the assumption about the classical relationship between lesion sites and aphasia syndromes (frontal lesions being related to the non-fluent aphasia, posterior lesions leading to fluent aphasia). The contribution of frontal and posterior brain areas to the processing of time reference assignment is supported by findings of Kielar, Milman, Bonakdarpour, and Thompson (2011) who focused directly on present and past tense production, as well as by a number of other fMRI and MEG studies focused on past tense (Dhond, Marinkovic, Dale, Witzel, & Halgren, 2003; Joanisse & Seidenberg, 2005; Tyler, Marslen-Wilson, & Stamatakis, 2005), in which distributed frontal-parietal and frontal-temporal networks were found to be activated during the processing of tense. Taking into account the prototypical relations between present time frame and imperfective aspect on the one hand, and past time frame and perfective aspect on the other (which has been hereby proposed for Russian), it is plausible that damage to language-related brain areas, both frontal and posterior, reduce processing resources necessary to implement correct time reference assignment, which, in turn, causes speakers to resort to prototypical temporal marking. This finding reveals otherwise hidden linguistic universals.

The minor differences found in the substitution patterns between the two aphasic groups in this study might be taken as evidence for at least partly differential involvement of frontal and posterior brain areas in time reference assignment. Non-fluent speakers demonstrated more proneness to an unsystematic switch between time frames (or even resorting to the use of timeless infinitives) and, thus, demonstrated a more general impairment. In contrast, fluent aphasic speakers’ performance can be explained by the strategies to use prototypical matches of aspect and time frame, and non-past time frames, other things being equal. This suggests that lesions in posterior brain areas do not necessarily cause disruption of those strategies. On the other hand, frontal brain areas seem to be critical for the strategic use of time reference–aspect matching. Damage to this region can cause a greater reduction of processing resources necessary for correct time reference assignment, resulting in instability of the system of temporal relations and simplification of the adapted strategies.

In conclusion, the present study showed that both non-fluent and fluent Russian aphasic speakers treat aspect as a predominantly lexical category which guides time reference assignment. Although the exact role of lesion sites are yet to be defined, striking similarities between performance of aphasic individuals and healthy children acquiring Russian suggest that limited processing resources which are characteristic of both populations evoke the same strategy: the use of cross-linguistically prototypical and cognitively grounded time reference–aspect matches.

Acknowledgments

We would like to thank Vasiliki Koukoulioti for fruitful discussions on Greek aspect and Kelly Callahan for proof reading the paper. We are also grateful to the aphasic and non-brain-damage individuals for participating in the study. This article is an output of a research project implemented as part of the Basic Research Program at the National Research University Higher School of Economics (HSE).
Appendix 2

The verbs used in the Russian test. The verbs were paired: each odd number was paired with the next even number (push–pull; paint-draw etc.). For each verb the imperfective and perfective forms were used, which are considered to be separate lexical items (see text).

<table>
<thead>
<tr>
<th>N</th>
<th>English translation</th>
<th>Russian imperfective</th>
<th>Russian perfective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>to push</td>
<td>tolikat</td>
<td>toliknut</td>
</tr>
<tr>
<td>2</td>
<td>to pull</td>
<td>tyanut’</td>
<td>podtyanut’</td>
</tr>
<tr>
<td>3</td>
<td>to paint</td>
<td>risovat’</td>
<td>narisovat’</td>
</tr>
<tr>
<td>4</td>
<td>to draw</td>
<td>cherit’</td>
<td>nacherit’</td>
</tr>
<tr>
<td>5</td>
<td>to knitt</td>
<td>vyazat’</td>
<td>svyazat’</td>
</tr>
<tr>
<td>6</td>
<td>to sew</td>
<td>shit’</td>
<td>sshit’</td>
</tr>
<tr>
<td>7</td>
<td>to empty</td>
<td>osvobozhdat’</td>
<td>osvobodit’</td>
</tr>
<tr>
<td>8</td>
<td>to fill</td>
<td>napolnyat’</td>
<td>napolnit’</td>
</tr>
<tr>
<td>9</td>
<td>to sharpen</td>
<td>tochit’</td>
<td>potochit’</td>
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<tr>
<td>10</td>
<td>to break</td>
<td>lomat’</td>
<td>slomat’</td>
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<tr>
<td>11</td>
<td>to tear</td>
<td>rvat’</td>
<td>porvat’</td>
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<tr>
<td>12</td>
<td>to glue</td>
<td>kleit’</td>
<td>prikleit’</td>
</tr>
<tr>
<td>13</td>
<td>to pour</td>
<td>nalivat’</td>
<td>nalit’</td>
</tr>
<tr>
<td>14</td>
<td>to drink</td>
<td>pit’</td>
<td>vypit’</td>
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<tr>
<td>15</td>
<td>to peel</td>
<td>chistit’</td>
<td>pochistit’</td>
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<tr>
<td>16</td>
<td>to eat</td>
<td>est’</td>
<td>s’est’</td>
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<tr>
<td>17</td>
<td>to iron</td>
<td>gladit’</td>
<td>pogladit’</td>
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<tr>
<td>18</td>
<td>to fold</td>
<td>skladyvat’</td>
<td>slozhit’</td>
</tr>
<tr>
<td>19</td>
<td>to sweep</td>
<td>podmetat’</td>
<td>podmesti</td>
</tr>
<tr>
<td>20</td>
<td>to mop</td>
<td>myt’</td>
<td>vymyt’</td>
</tr>
</tbody>
</table>
Appendix 3

Individual scores (the maximum score is 20 per condition).

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Imperfective</th>
<th>Perfective</th>
<th>Total</th>
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<tr>
<td></td>
<td></td>
<td>Present</td>
<td>Past</td>
<td>Future</td>
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<tr>
<td>Non-fluent</td>
<td>1</td>
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<td>8</td>
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<td>2</td>
<td>11</td>
<td>16</td>
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<td>3</td>
<td>12</td>
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<td>15</td>
<td>9</td>
<td>18</td>
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<td></td>
<td>14.4</td>
<td>9.1</td>
<td>10.1</td>
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<tr>
<td>Fluent</td>
<td>8</td>
<td>18</td>
<td>7</td>
<td>2</td>
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<td>14</td>
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<tr>
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<td>16.3</td>
<td>8.9</td>
<td>10.4</td>
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References


