National Research University Higher School of Economics

as a manuscript

Dragoy Olga

ASPECTS OF TIME:
TENSE AND ASPECT PROCESSING
ACROSS TYPICAL AND ATYPICAL LANGUAGE SPEAKERS

Dissertation Summary
for the purpose of obtaining
academic degree Doctor of Science in Philology and Linguistics

Academic Advisor:

PhD, Bastiaanse Y. R. M.

Moscow 2020

The dissertation was prepared at the Center for Language and Brain, National Research University "Higher School of Economics".

Publications

Seven publications were selected for the defense. The corresponding author is marked with an asterisk. In four of them, Olga Dragoy is the first author. All articles are indexed in the Web of Science database and are published in journals included in the first or the second quartile of the Scopus or the Web of Science.

1. Dragoy, O., Stowe L.A., Bos, L.S., & Bastiaanse*, R. (2012). From time to time: processing time reference violations in Dutch. *Journal of Memory and Language, 66*, 307-325. DOI 10.1016/j.jml.2011.09.001
2. Bos*, L.S., Dragoy, O., Stowe, L.A., Bastiaanse, R. (2013). Time reference teased apart from tense: Thinking beyond the present. *Journal of Neurolinguistics, 26*, 283-297. DOI 10.1016/j.jneuroling.2012.10.001
3. Brederoo, S.G., Bos, L.S., Dragoy, O., Bastiaanse, R, & Baggio*, G. (2015). Gamma Oscillations as a Neural Signature of Shifting Times in Narrative Language. *PLoS ONE, 10*(4). DOI 10.1371/journal.pone.0121146
4. Dragoy*, O., & Bastiaanse, R. (2010). Verb production and word order in Russian agrammatic speakers. *Aphasiology, 24*(1), 28-55. DOI 10.1080/02687030802586902
5. Dragoy*, O., & Bastiaanse, R. (2013). Aspects of time: time reference and aspect production in Russian aphasic speakers. *Journal of Neurolinguistics, 26*, 113-128. DOI 10.1016/j.jneuroling.2012.05.003
6. Bos*, L., Dragoy, O., Avrutin, S., Iskra, E., & Bastiaanse, R. (2014). Understanding discourse-linked elements in aphasia: a threefold study in Russian. *Neuropsychologia, 57*, 20-28. DOI 10.1016/j.neuropsychologia.2014.02.017
7. Dragoy*, O., Virfel, E., Bastiaanse, R., Yurchenko, A. (2019). Aspect and tense attrition in Russian-German bilingual speakers. *International Journal of Bilingualism, 23*(1), 275-295. DOI 10.1177/1367006917728388

The results associated with the current study were also presented in the following papers:

8. Dragoy, O., Bergelson, M., Iskra, E., Laurinavichyute, A., Mannova, E., Skvortsov, A., & Statnikov, A. (2016). Comprehension of Reversible Constructions in Semantic Aphasia. *Aphasiology, 30*(1), 1-22.
9. Dragoy, O., Akinina, Y., & Dronkers, N. (2017). Toward a functional neuroanatomy of semantic aphasia: A history and ten new cases. *Cortex, 97*, 164-182.

10. Akinina, Y., Dragoy, O., Ivanova, M., Iskra, E., Soloukhina, O., Petryshevsky, A., Fedina, O., Turken, A., Shklovsky, V., & Dronkers, N. (2019). Grey and white matter substrates of action naming. *Neuropsychologia, 131*, 249-265.
11. Akinina, Yu., Malyutina, S., Ivanova, M., Iskra, E., Mannova, E., & Dragoy, O. (2015). Russian normative data for 375 action pictures and verbs. *Behavior Research Methods, 47*(3), 691-707.
12. Ivanova, M., Dragoy, O., Kuptsova, S., Ulicheva, A., & Laurinavichyute, A. (2015). The contribution of working memory to language comprehension: Differential effect of aphasia type. *Aphasiology, 29*(6), 645-664.
13. Ivanova, M., Isaev, D. Y., Dragoy, O., Akinina, Y., Petrushevsky, A. Fedina, O., & Dronkers, N. (2016). Diffusion-tensor imaging of major white matter tracts and their role in language processing in aphasia. *Cortex, 85*, 165–181.
14. Ivanova, M.V., Dragoy, O.V., Kuptsova, S.V., Akinina, S. Yu., Petrushevskii, A.G., Fedina, O.N., Turken, A., Shklovsky, V.M., & Dronkers, N.F. (2018). Neural mechanisms of two different verbal working memory tasks: A VLSM study. *Neuropsychologia, 115*, 25-41.
15. Laurinavichyute, A., Jäger, L. A., Akinina, Y., Roß, J., & Dragoy, O. (2017). Retrieval and Encoding Interference: Cross-Linguistic Evidence from Anaphor Processing. *Frontiers in Psychology, 8*, 965.
16. Laurinavichyute, A.K., Ulicheva, A., Ivanova, M.V., Kuptsova, S.V., & Dragoy, O. (2014). Processing lexical ambiguity in sentential context: Eye-tracking data from brain-damaged and non-brain-damaged individuals. *Neuropsychologia, 64*, 360-373.
17. Lopukhina, A., Laurinavichyute, A., Lopukhin, K., & Dragoy, O. (2018). The Mental Representation of Polysemy across Word Classes. *Frontiers in Psychology, 9*, 192.
18. Malyutina, S., Dragoy, O., Ivanova, M., Laurinavichyute, A., Petrushevsky, A., Meindl, T., Pöppel, E., & Gutyrchik, E. (2016). Fishing is not wrestling: Neural underpinnings of the verb instrumentality effect. *Journal of Neurolinguistics, 40*, 37-54.
19. Malyutina, S., Iskra, E., Sevan, D., & Dragoy, O. (2014). The effects of instrumentality and name relation on action naming in Russian speakers with aphasia. *Aphasiology, 28*(10), 1178-1197.
20. Mołczanow, J., Iskra, E., Dragoy, O., Wiese, R., & Domahs, U. (2019). Default stress assignment in Russian: evidence from acquired surface dyslexia. *Phonology, 36*(1), 61-90.
21. Yurchenko, A., Golovteev, A., Kopachev, D., Dragoy, O. (2017). Comprehension and production of nouns and verbs in temporal lobe epilepsy. *Epilepsy & Behavior, 75*, 127-133.

22. Yurchenko, A., den Ouden, D.-B., Hoeksema, J., Dragoy, O., Hoeks, J., & Stowe, L.A. (2013). Processing Polarity: ERP Evidence for Differences between Positive and Negative Polarity. *Neuropsychologia*, *51*(1), 132-141.

Conference presentations

The results of the study have been disseminated since 2008 in 37 oral and poster presentations at 18 different Russian and international conferences, including:

- International Science of Aphasia Conference (2008, 2009, 2010, 2011, 2013, 2017);
- Annual Meeting of the Academy of Aphasia (2013);
- Annual CUNY Conference on Human Sentence Processing (2011, 2015, 2016);
- Annual Meeting of the Society for the Neurobiology of Language (2015);
- European Workshop on Cognitive Neuropsychology (2009, 2012, 2016);
- Learning and Plasticity (LaP) Meeting (2017);
- International Conference on Cognitive Science (2008, 2012);
- Cognitive science in Moscow: New research (2011, 2013, 2015, 2017).

1. Introduction

The papers presented in this dissertation are dedicated to the experimental study of time reference across typical (non-brain-damaged monolingual) and atypical (brain-damaged or bilingual language attritor) adult language speakers. Initial cross-linguistic reports have highlighted that people with brain damage and the resulting aphasia (an acquired language impairment) experience more difficulties with past tense verb forms than with present or future tense forms (Bastiaanse, 2008; Simonsen & Lind, 2002; Yarbay Duman & Bastiaanse, 2009). Further research has revealed that those difficulties are related not to past tense, but to reference to past semantics, irrespective of the linguistic device used to convey such reference. Indeed, tense is among the most common means to express time reference. However, non-finite participles referring to the past were shown to be as impaired in aphasia, as were finite past verb forms (Bastiaanse, 2008). Similarly, perfective verb forms in general were more problematic than imperfective verb forms in Greek (Nanousi, Masterson, Druks, & Atkinson, 2006; Stavrakaki & Kouvava, 2003). These data gave rise to the PAst DIscourse LInking Hypothesis (PADILIH; Bastiaanse et al., 2011), which suggests that this specific deficit is caused by the discourse-related nature of past time reference: it requires a relation established between speech time and an earlier event – that is, discourse linking. No such linking is required for a verb form referring to the present, as the time of speech and the time of the event coincide. The PADILIH also conformed to earlier reports on a range of similar linguistic phenomena: reflexive pronouns and who-questions are better preserved in individuals with aphasia and are acquired earlier by children than anaphoric pronouns and which-questions, respectively (Avrutin, 2006; Hickok & Avrutin, 1995), because only the latter two require processing at the level of a broader context and need discourse linking.

The goal of the studies included in this dissertation was to test the universality of the PADILIH, which is still an open relevant research question. The first specific objective was to test whether, similarly to individuals with aphasia, the brains of healthy people are sensitive to the reference to different time frames and to the shifts between them. That question was addressed using electrophysiological measures of healthy Dutch speakers' reactions to verb forms referring to the past and non-past, in three experiments. The second objective was to test whether the PADILIH's specific prediction about past time reference and Avrutin's (2006) broader prediction on other similar phenomena are cross-linguistically valid. To answer this question, we performed three behavioral experiments: we tested brain-damaged individuals with aphasia who were native speakers of Russian, a language with a complex interaction between the verb categories of tense and aspect. Finally, the third objective was to test whether, once acquired, the means of time reference in a language are

subject to attrition under the influence of another language with a different repertoire of time reference means. That issue was studied by employing the similarities and differences in the tense-aspect systems of Russian and German, and by testing the linguistic behavior of bilingual speakers of these two languages. Taken together, the presented studies used behavioral and electrophysiological methods, characteristic properties of three languages (Dutch, Russian and German), a thorough experimental design regarding both the selected materials and the experimental procedures, and up-to-date statistical approaches to empirical data analysis, which constitute the novelty of the work.

In four of the papers included in this dissertation, Olga Dragoy is the first author. Her contribution to the three other co-authored papers is as follows. In the paper by Bos, Dragoy, Stowe, and Bastiaanse (2013), both Olga Dragoy and Laura Bos were involved in conducting the experiment, analyzing the data and preparing the draft of the paper. In the paper by Brederoo, Bos, Dragoy, Bastiaanse, and Baggio (2015), Olga Dragoy co-supervised the project at the stages of the study conception and design, and also considerably contributed to the data analysis. For the paper by Bos, Dragoy, Avrutin, Iskra, and Bastiaanse (2014), Olga Dragoy co-supervised the design of the project, developed the Russian materials, supervised the data collection and contributed to the draft of the paper.

The following theses are proposed for the defense:

(1) Reference to the past and to the non-past, expressed through verb forms, is processed differently in the healthy brain, irrespectively of tense: non-past is related to local morphosyntactic processing signatures, while past features discourse integration mechanisms.

(2) Shifts between linguistically expressed past and present time reference are taxing for the healthy brain and are processed in the gamma band frequency of brain oscillations.

(3) Russian speakers with post-stroke aphasia are sensitive to the grammatical information expressed in verbs and, specifically, to the prototypical and non-prototypical matches of time reference and aspectual semantics.

(4) In Russian-German bilingual speakers, Russian tense and – to a larger degree – aspect are vulnerable to attrition, with an advantage for the prototypical match of temporal and aspectual semantics.

(5) Individuals with aphasia experience consistent problems with a range of linguistic expressions requiring discourse linking.

Altogether, the obtained evidence confirms the cross-populational and cross-linguistic relevance of the PADILIH, but highlights a strong modulation of time reference processing by language-specific categories.

2. Electrophysiology of time referencing in healthy individuals

Papers selected for the defense: Dragoy et al. (2012); Bos et al. (2013); Brederoo et al. (2015)

While it can be specifically problematic for individuals with aphasia, past time reference is relevant for language processing in healthy people too. The available behavioral data provide evidence that non-brain-damaged individuals process reference to the past and present differently. For example, Dutch healthy speakers take longer to complete a sentence with a finite verb in past tense than in present tense (Jonkers, Boers, Koopmans, Menninga, & Zoodsma, 2007). Faroqi-Shah and Dickey (2009) reported longer reaction times in a grammaticality judgment task for past verb forms than for present verb forms in both agrammatic and healthy English speakers, where verb forms violated the previous temporal context (e.g., 'Yesterday, the student knows the answer' vs. 'Tomorrow, the cancer patient needed an X-ray').

The goal of the first series of studies included in the dissertation was to reveal electrophysiological implications of present and past time reference processing by non-brain-damaged individuals. It was of interest to see whether such a theoretically grounded and behaviorally supported distinction between local binding and discourse linking in general, and between present and past time reference in particular, finds support at the neurophysiological level in healthy speakers. For that, the method of event-related brain potentials (ERPs) was chosen, as it is characterized by a fine-grained temporal resolution and it is sensitive to subtle brain processing differences. Electrophysiological signatures of discourse linking and of local binding have never been addressed directly before, but very relevant work was done, for example, by Baggio (2008) and Steinhauer and Ullman (2002). Based on that available literature, we hypothesized that present tense processing involves binding via syntax, which implies that a tense violation elicits a typical syntactic processing pattern – that is, the so-called P600 effect. In contrast, if the processing of past tense is accomplished via discourse linking and not as a morphosyntactic agreement, those ERP responses are not expected.

In the first experiment, non-brain-damaged speakers of Dutch were presented with sentences containing a time reference violation, in which a lexical adverb referring to the past was followed by a present tense verb (1) or a lexical adverb referring to the present was followed by a past tense verb (2), along with the correct counterparts of the two conditions.

(1)	De kelner	die	zonet	de peper	maalt	krijgt	geen fooi.
	the waiter	who	just before	the pepper	grinds gets	no tip	

*The waiter who is just before grinding the pepper doesn't get a tip.

(2) De kelner	die	nu	de peper	maalde	krijgt	geen fooi.
the waiter	who	now	the pepper	ground	gets	no tip

*The waiter who now ground the pepper doesn't get a tip.

The results showed that participants' brains reacted to the violation of the past time context by the present tense verb as soon as it was presented and considered it a morphosyntactic violation, evidenced by the P600 effect time-locked to the target verb. In contrast, the present time reference violation by a past tense verb did not elicit an immediate ERP response. However, both violation types elicited a similar negativity at the end of the sentence, time-locked to the final word, which we interpreted as an attempt to repair the time reference mismatch based on the complete information provided in the sentence. These data supported the idea that the processing of present and past time reference relies on qualitatively different neural processes, in line with the PADILIH's suggestion that past but not present tense is discourse-linked.

While in the first experiment we used non-past (present) tense forms of verbs referring to the non-past (present) and past tense forms referring to the past, in the second experiment we aimed to find support for the discourse linking hypothesis by testing violations with periphrastic verb forms, so that tense and time reference can be teased apart. We predicted that local binding does not occur for the past time reference, rather than for the past tense, and did not expect a P600 effect in response to a periphrastic verb form in the present tense, but referring to the past. Non-brain-damaged speakers of Dutch were presented with sentences either containing a time reference violation in which a lexical adverb referring to the past was followed by a present tense periphrastic verb form referring to the non-past (future; see 3), or its correct counterpart in which a lexical adverb referring to the past was followed by a present tense, perfect aspect periphrastic verb form referring to the past (4). This design allowed us to test the effect of time reference alone, decoupled from any potential tense effect, because both periphrastic verb forms were in the present tense, but referred to different time frames.

(3)	De opa	die	zonet	de koffie	gaat malen	zorgt voor zijn bezoek.
	the grandpa	who	just before	the coffee	will grind	looks after his visitors

*The grandpa who just before will grind the coffee looks after his visitors.

(4)	De opa	die	zonet	de koffie	heeft gemalen	zorgt voor zijn bezoek.
	the grandpa	who	just before	the coffee	has ground	looks after his visitors

The grandpa who just before ground the coffee looks after his visitors.

As expected, the contrast between such sentences resulted in a P600 effect that was time-locked to the present tense auxiliary of the non-congruent periphrastic verb form. That is, it was the time reference value rather than the tense value of the verb that caused the ERP response. Similar to the first experiment with simple verb forms, auxiliaries referring to the non-past evoked a P600 in the context of a time reference violation. Thus, the electrophysiological response of non-brain-damaged individuals is caused by the time reference of the complete verb form, rather than by the tense.

Unlike the critical sentences used in the first two experiments that contained violations, the linguistic materials used in the third experiment was limited to normal sentences which occur in everyday speech but represent interesting cases of mental time shifting between the past and non-past. The goal of this study was to investigate the electrophysiological signatures of such shifting in a narrative context, and to measure the costs of the respective semantic integration into a previous context. Instead of using ERPs, we analyzed power modulations of the recorded electrophysiological signal in various frequency bands. Dutch non-brain-damaged individuals were presented with sentences containing a past time reference context (either punctual (5) or iterative (6)), the adverb 'now', and the second clause with the main verb in past tense.

(5)	Een uur geleden	pikte	de jongen	een snoepje	en	nu	schilde hij	de vrucht.
	An hour ago	stole	the boy	a candy	and	now	peeled he	the fruit

An hour ago the boy stole a candy and now he peeled the fruit.

(6)	De hele middag	pikte	de jongen	snoepjes	en	nu	schilde	hij de vrucht.
	The whole afternoon	stole	the boy	candies	and	now	peeled	he the fruit

The entire afternoon the boy stole candy and now he peeled the fruit.

In the punctual condition, 'an hour ago' introduced the past time frame, then 'now' shifted the narrative to the present, and 'peeled' shifted it back to the past. We predicted that these two referential shifts would result in similar neural responses. In contrast, in the iterative condition, 'the entire afternoon' did not specify any particular time frame (it may be past, present or future), so that both 'now' and 'peeled' were consistent with it. Here were expected no time shift and consequently no electrophysiological effect. In line with the predictions, we found a similar increase in gamma power in the left frontal electrodes at the word 'now' and at the second verb in the punctual contexts, and no gamma bursts in the iterative contexts. The results, thus, revealed the electrophysiological signatures of linguistically induced time shifts.

Taken together, the three experiments provide evidence for the sensitivity of non-brain-damaged individuals to the difference between processing various time-reference violations and to

linguistically expressed time shifts. The observed effects are usually not seen in the accuracy of performance, because unlike brain-damaged people with aphasia, healthy language speakers usually perform at ceiling. However, at the electrophysiological level, their brains differentiate past time reference from non-past time reference, as well as reacting to communicative situations where a mental time shift between the past and non-past is required or not.

3. Time reference and aspect impairments in individuals with aphasia

Papers selected for the defense: Dragoy & Bastiaanse (2010); Dragoy & Bastiaanse (2013); Bos et al. (2014)

Previous aphasiological literature on time reference has mostly focused on the difference between processing past and non-past time frames. However, many languages feature temporal semantics that are often expressed through tense, which interact with aspectual semantics that are expressed through grammatical or lexical aspect (Plungian, 2000). For example, in Russian, aspect is a lexical-grammatical category obligatorily expressed by each verb and interacting with both tense and time reference in a complex way. 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 that is neither initial nor final), which are expressed through verb morphology (Zaliznyak & Shmelev, 2000). The goal of the second series of our studies was to test the PADILIH in a broader cross-linguistic context – in post-stroke Russian speakers with aphasia of mild-to-moderate severity (as suggested by Akhutina (1978)).

Due to the lack of previous clinical studies of verbs in Russian (but see Polonskaya (1978)), in the first experiment we tested whether Russian brain-damaged individuals with agrammatic aphasia experience problems with the implementation of grammatical information contained by a verb. Specifically, we manipulated the number and type of arguments associated with a verb – the two factors shown to affect performance of English and Dutch speakers with aphasia (Bastiaanse & Van Zonneveld, 2005; Thompson, 2003). We used a sentence production priming paradigm, in which an experimenter described one picture with a sentence, and an agrammatic speaker produced a sentence in response to the other picture, following the same structure. Six experimental conditions were used, involving unaccusative and medial verbs with direct and inverted word order and their transitive counterparts:

(7) Unaccusative condition (transitive/ intransitive direct word order/ inverted word order):

Mal'chik rassypal kartoshku.	Kartoshka rassypalas.	Rassypalas' kartoshka.
boyNom spilled potatoesAcc	potatoesNom spilledRefl	spilledRefl potatoesNom
The boy spilled the potatoes.	The potatoes spilled.	The potatoes spilled.

(8) Medial condition (transitive/ intransitive direct word order/ inverted word order):

Koza bodaet sobaku.	Koza bodaets'a.	Bodaets'a koza.
goatNom butts dogAcc	goatNom buttsRefl	buttsRefl goatNom
The goat butts the dog.	The goat butts.	The goat butts.

Firstly, the number of arguments explicitly used in a sentence distinguishes between transitive verbs and their one-argument alternations. Based on previously tested languages, we predicted that sentences with one argument would be easier to produce than sentences with two arguments, other things being equal. Secondly, an unaccusative transformation implemented in one-argument sentences with verbs such as 'to break' was hypothesized to be more difficult to produce than the medial transformation in verbs such as 'to bite' in transitive sentences, due to the presence of syntactic movement in the former, but not in the latter. Finally, the scrambling involved in sentences with indirect word order was another factor hypothesized to affect sentence production by speakers with agrammatism. The results showed that the increased number of verb arguments and syntactic operations concerning constituent movement caused production problems in the Russian agrammatic speakers.

Since Russian speakers with agrammatic aphasia turned out to be sensitive to the amount of grammatical information conveyed by a verb, the second clinical experiment focused on exploring the time reference deficit in Russian speakers with aphasia. Specifically, we tested whether reference to the past through verb morphology was universally problematic in aphasia or whether it depended on other verb categories, such as aspect. Previous cross-linguistic data (Bastiaanse et al., 2011) suggested that, in people with aphasia, verb forms expressing reference to the past or conveying perfective semantics were more impaired than verb forms expressing reference to the non-past (present or future) or conveying imperfective semantics, both in comprehension and production. By systematically testing the interaction of tense and aspect, we investigated whether it holds true for Russian and if it is specific to agrammatic aphasia.

Four verb forms (past perfective, e.g. *napisal* "has written/ wrote"; non-past perfective, e.g. *napishet* "will have written"; past imperfective, e.g. *pisal* "was writing"; and non-past imperfective, e.g. *pishet* "is writing") were elicited in a sentence context in Russian post-stroke speakers with non-

fluent (agrammatic) and fluent aphasia. The results revealed that in both aphasia groups verb forms with non-past time reference were easier to produce than forms with past time reference. However, an interaction between tense and aspect was found: imperfective verbs were better produced in non-past tense, whereas perfective verbs were more easily produced in past tense. Unlike previously reported data, this suggests that the advantage of a particular time reference depends also on aspectual characteristics of the verb. The results are explained in terms of prototypical and non-prototypical matches of time reference and aspectual semantics: perfectives primarily refer to completed events in the past, while imperfectives prototypically describe ongoing, non-past events.

Furthermore, in the third experiment, we tested the discourse linking hypothesis including, but also beyond, time reference expressed through verbs. From a theoretical point of view, non-past time reference, who-questions, and reflexive pronouns are processed by narrow syntax alone. In contrast, past time reference, which-questions, and personal pronouns need additional access to discourse to link to their referent outside the clause (Avrutin, 2006). We sought empirical evidence supporting that the latter linguistic expressions present more difficulty for individuals with aphasia than the former, within the group of Russian participants with post-stroke aphasia. Individuals with fluent and non-fluent aphasia were invited to perform a sentence-picture matching task with the following conditions:

	Local binding	Discourse linking
(9) Time reference	Muzhchina rv'ot bumagu.	Muzhchina porval bumagu.
	man-NOM tears paper-ACC	man-NOM tore paper-ACC
	The man is tearing paper.	The man tore the paper.
(10) Wh-questions	Kto nes'ot zhenschinu?	Kakoj muzhchina nes'ot zhenschinu?
	who-NOM carries woman-ACC	which man-NOM carries woman-ACC
	Who is carrying a woman?	Which man is carrying a woman?
(11) Pronouns	Zhenschina kataetsa.	Zhenschina kataet jejo.
	woman-NOM carts-REFL	woman-NOM carts her-ACC
	The woman carts herself.	The woman carts her.

The results showed that individuals with non-fluent, agrammatic aphasia experience more difficulties when comprehending sentences with verbs referring to the past and which-questions, but perform at ceiling in both pronominal conditions. Participants with fluent aphasia were sensitive to discourse linking in all three tasks and performed with less accuracy in sentences with verbs referring to the past, which-questions and personal pronouns.

All in all, the second series of studies included in the dissertation showed that Russian speakers with post-stroke aphasia are sensitive to grammatical information expressed by a verb; specifically, reference to the past is difficult for them irrespectively of the aphasia type. However, processing prototypical correspondence of time reference and aspectual semantics are largely advantageous compared to non-prototypical ones. This is in line with a similar association between the distinction of perfective/imperfective and past/non-past time reference, which is often observed across languages (Dahl, 1985). This suggests that processing prototypical matches of time reference and aspect may consume less resources and become a preferred strategy (Avrutin, 2000; 2006) at least for Russian, with its specific tense and aspect systems. Additionally, in line with Avrutin's (2006) prediction, we showed that individuals with aphasia experience consistent problems with a range of linguistic expressions requiring discourse linking: past tense, anaphoric pronouns and which-questions – in contrast to their non-discourse linked counterparts (present tense, reflexive pronouns, who-questions).

4. Tense and aspect attrition in bilingual individuals

Paper selected for the defense: Dragoy et al. (2019)

In the absence of brain damage, bilingual language speakers who show signs of attrition of one of their languages, as compared to monolingual language speakers, may be considered as atypical language speakers of that attrited language. Specifically, it has been shown that their grammar has considerable deviations from the monolingual grammar regarding aspect and tense processing (Bar-Shalom & Zaretsky, 2008; Montrul, 2002). One of the factors causing such deviation is first language attrition under the influence of the second – more dominant – language (Schmid, 2011). In this study, we focused on the interaction of two tense/aspect systems in Russian-German bilingual individuals.
The two languages have a comparable inventory to express tense, but significantly differ in the expression of aspectual distinctions. In German, the internal constituency of an event can only be specified with lexical means, while Russian verb forms are explicit about aspect.

We tested a group of monolingual Russian speakers and a group of adult Russian-German bilingual speakers who immigrated to Germany between the ages of 6 and 15 and subsequently

acquired German as their second, but dominant, language. Sentences with a temporal setting phrase either referring to the past (e.g., yesterday) or future (e.g., tomorrow), an aspectual setting phrase that was either imperfective (e.g., all day long) or perfective (e.g., in several hours), and a perfective or imperfective verb in the past tense were presented auditorily to participants in an error detection task. One third of experimental sentences were correct, like in (12), since the verb form was congruent with both setting phrases. Two thirds were incorrect, because the verb form violated either the temporal or the aspectual semantics of the context (13-14).

(12) Na proshloj nedele tselyje vyhodnyje malyar krasil zabor svoej tjoschi. / Vchera za paru sekund devushka pochistila tufli prijatelja.

Last week, for the whole weekend, the decorator was painting the fence of his mother-in-law. / Yesterday, in a couple of seconds, the girl cleaned the shoes of a friend.

(13) *Na proshloj nedele za neskolko chasov malyar krasil zabor svoej tjoschi. / *Vchera tselyh desjat' minut devushka pochistila tufli prijatelja.

*Last week, in several hours, the decorator was painting the fence of his mother-in-law. / *Yesterday, for the whole ten minutes, the girl cleaned the shoes of a friend.

(14) *V grjaduschem mesjatse tselyje vyhodnyje malyar krasil zabor svoej tjoschi. / *Zavtra vecherom za paru sekund devushka pochistila tufli prijatelja.

*In the coming month, for the whole weekend, the decorator was painting the fence of his mother-in-law. / *Tomorrow evening, in a couple of seconds, the girl cleaned the shoes of a friend.

While performing similarly on the correct sentences condition, monolingual and bilingual speakers significantly differed in the accuracy of violation identification. The difference was driven by those bilingual individuals who became exposed to German before 11 years old: they detected both temporal and aspectual violations less accurately than monolingual speakers. The ability to identify violations was especially affected in bilingual speakers who had low Russian exposure after immigration, with a larger effect for sentences with aspectual mismatches. Those bilingual speakers who immigrated after 11 years old, in contrast, demonstrated better performance on identifying violations of perfective verbs than imperfective verbs in the past tense.

The result show that, irrespective of the specific representations of tense and aspect in the two interacting languages, both categories are vulnerable to attrition in individuals with a pre-pubertal (before 11 years old) bilingualism onset. Additionally, it is only under the condition of limited or no exposure to Russian after immigration that the Russian aspect undergoes significant erosion, being

influenced by the more dominant German with no exactly corresponding grammatical category. Finally, we found an effect of the advantage of the prototypical match of past tense with perfective verbs over the non-prototypical match of past tense with imperfective verbs – in those bilingual speakers who continued to be considerably exposed to Russian after immigration.

5. Conclusions

Experiments included in this dissertation studied how typical (non-brain-damaged monolingual) and atypical (brain-damaged or bilingual language attritors) adult speakers of Dutch, Russian and German speakers process verb characteristic of tense and aspect, with a special focus on time reference expressed through or modulated by these categories. In the experiments, we were the first or among the first to use the method of event-related potentials to look at time reference processing, as well as to study tense and aspect processing in Russian individuals with aphasia. In others (e.g., devoted to aspect attrition in bilingual speakers), we added more understanding to the mechanisms of language processing in specific populations.

Largely driven by the PADILIH (Bastiaanse et al., 2011), this dissertation supports that processing in both healthy non-brain-damaged people and individuals with aphasia is different for linguistic expressions requiring discourse linking and those that do not. It has consistently been shown for past vs. non-past time reference, expressed through different verb forms, but also extends to a range of other linguistic expressions (pronouns, wh-questions), where such a dichotomy applies. Importantly, the effect is independent of grammatical marking and morphological complexity. However, a more taxing nature of expressions requiring discourse linking is modulated by additional linguistic categories, as we showed for the interaction of temporal and aspectual semantics in Russian. Thus, the obtained evidence confirms the cross-populational and cross-linguistic relevance of the PADILIH, but highlights the impact of language-specific properties on processing discourse-linked linguistic phenomena.

References

Avrutin, S. (2000). Comprehension of discourse-linked and non-discourse-linked questions by children and Broca's aphasics. In Y. Grodzinsky, L. Shapiro, & D. Swinney (Eds.), *Language and the brain: Representation and processing* (pp. 295–313). San Diego: Academic Press.

Avrutin, S. (2006). Weak syntax. In Y. Grodzinsky, & K. Amunts (Eds.), *Broca's region* (pp. 49–62). Oxford: Oxford University Press.

Akhutina T. V. (1978). O ponimanii i postroenii aktivnyh/passivnyh konstruktsij bolnymi s afaziej [About comprehension and production of active/passive constructions by patients with aphasia]. *Badania lingwistyczne nad afazja*. Warszawa, Ossolineum, 31–38.

Baggio, G. (2008). Processing temporal constraints: An ERP study. *Language Learning, 58*, 35–55.

Bar-Shalom, E. G., & Zaretsky, E. (2008). Selective attrition in Russian-English bilingual children: Preservation of grammatical aspect. *International Journal of Bilingualism, 12*, 281–302.

Bastiaanse, R. (2008). Production of verbs in base position by Dutch agrammatic speakers: Inflection versus finiteness. *Journal of Neurolinguistics, 21*, 104–119.

Bastiaanse, R., Bamyaci, E., Hsu, C., Lee, J., Yarbay Duman, T., & Thompson, C. K. (2011). Time reference in agrammatic aphasia: A cross-linguistic study. *Journal of Neurolinguistics, 24*, 652–673.

Bastiaanse, R., & van Zonneveld, R. (2005). Sentence production with verbs of alternating transitivity in agrammatic Broca's aphasia. *Journal of Neurolinguistics, 18*, 57–66.

Dahl, Ö. (1985). *Tense and aspect systems*. New York: Basil Blackwell.

Faroqi-Shah, Y., & Dickey, M. W. (2009). On-line processing of tense and temporality in agrammatic aphasia. *Brain and Language, 108*, 97–111.

Hickok, G., & Avrutin, S. (1995). Representation, referentiality, and processing in agrammatic comprehension: two case studies. *Brain and Language, 50*, 10–26.

Jonkers, R., Boers, J., Koopmans, F., Menninga, A., & Zoodsma, J. (2007). (Reactie)tijd. *TABU, 36*, 117–126.

Montrul, S. (2002). Incomplete acquisition and attrition of Spanish tense/aspect distinctions in adult bilinguals. *Bilingualism: Language and Cognition, 5*, 39–68.

Nanousi, V., Masterson, J., Druks, J., & Atkinson, M. (2006). Interpretable vs. uninterpretable features: evidence from six Greek speaking agrammatic patients. *Journal of Neurolinguistics, 19*, 209–238.

Plungian, V. A. (2000). *Obschaja morfologija: Vvedenie v problematiku*. [General morphology: an Introduction]. Moskva: URSS.

Polonskaya N. N. (1978). Aktualizatsija glagolov pri afazii [Retrieval of verbs in aphasia]. *The Moscow University Herald, 2*, 62–67.

Schmid, M. S. (2011). *Language attrition*. Cambridge: Cambridge University Press.

Simonsen, H. G., & Lind, M. (2002). Past tense expression in a Norwegian man with Broca's aphasia. In F. Windsor, M. L. Kelly, &N. Hewkett (Eds.), *Investigations in clinical linguistics and phonetics* (pp. 44–56). London: Lawrence Erlbaum.

Stavrakaki, S., & Kouvava, S. (2003). Functional categories in agrammatism: evidence from Greek. *Brain and Language, 89*, 129–141.

Steinhauer, K., & Ullman, M. T. (2002). Consecutive ERP effects of morpho-phonology and morpho-syntax. *Brain and Language, 83*, 62–65.

Thompson, C. K. (2003). Unaccusative verb production in agrammatic aphasia: The argument structure complexity hypothesis. *Journal of Neurolinguistics, 16*, 151–167.

Yarbay Duman, T., & Bastiaanse, R. (2009). Time reference through verb Inflection in Turkish agrammatic aphasia. *Brain and Language, 108*, 30–39.

Zaliznyak, A. A., & Shmelev, A. D. (2000). *Vvedenie v russkuju aspectologiju*. [Introduction to Russian aspectology]. Moskva: Jazyki russkoj kultury.