

ПАДЕЖНАЯ НЕОДНОЗНАЧНОСТЬ ПРИ ВОСПРИЯТИИ (ЭКСПЕРИМЕНТАЛЬНОЕ ИССЛЕДОВАНИЕ НА МАТЕРИАЛЕ РУССКОГО ЯЗЫКА)

Слюсарь Н. А. (slioussar@gmail.com)

Утрехтский лингвистический институт, Утрехт, Нидерланды;
СПбГУ, Санкт-Петербург, Россия

Череповская Н. В. (ajmi@yandex.ru)

СПбГУ, Санкт-Петербург, Россия

Ключевые слова: морфологическая неоднозначность, падеж, ошибки в согласовании с интерференцией, русский язык, восприятие

PROCESSING OF CASE MORPHOLOGY: EVIDENCE FROM RUSSIAN

Slioussar N. A. (slioussar@gmail.com')

Utrecht Institute of Linguistics OTS, Utrecht, Netherlands;
Saint-Petersburg State University, Saint-Petersburg, Russia

Cherepovskaia N. V. (ajmi@yandex.ru)

Saint-Petersburg State University, Saint-Petersburg, Russia

Many studies discuss how morphological ambiguity influences processing. In particular, it is well known that attraction errors in subject-verb agreement are produced more often and cause smaller delay in comprehension if the form of the intervening noun coincides with the Nominative case form. This is the case in the German example *die Stellungnahme gegen die Demonstrationen waren...* 'the position against the demonstrations (Acc. Pl=Nom.Pl) were' as opposed to *die Stellungnahme zu den Demonstrationen waren...* 'the position on the demonstrations (Dat.Pl≠Nom.Pl) were'. However, the explanation of this phenomenon is a matter of debate. How are such errors produced or missed in comprehension, how are ambiguous forms represented so that they can influence this process?.. We offer a novel perspective on this problem by looking at novel data. We conducted two self-paced reading experiments exploring how Russian adjective forms ambiguous for case influence processing of case errors on the following nouns. We compare sentences containing errors like *fil'my bez izvestnyh akterah* 'movie.^{NOM.PL} without famous.^{GEN.PL=PREP.PL} actor.^{PREP.PL}' and *fil'my bez izvestnyh akteram* 'movie.^{NOM.PL} without famous.^{GEN.PL=DAT.PL} actor.^{DAT.PL}' to grammatically correct sentences. Errors of the first type are detected later and their effect is less pronounced. The results help answering several questions that arise in connection with attraction errors in subject-verb agreement.

Keywords: morphological ambiguity, case, attraction errors, agreement, Russian, comprehension

1. Introduction

This paper addresses the question how morphologically ambiguous forms are processed and influence the processing of other words. Our study focuses on case ambiguity in Russian adjectives, but we will start with another piece of data because it has already been studied experimentally in several languages. So we will use it to establish the necessary background and will refer to it later when interpreting the results of our experiments.

In the last two decades, many production and comprehension studies analyzed so-called agreement attraction errors. The data came from a variety of languages including Russian (e.g. Bock, Miller 1991; Eberhard et al. 2005; Fayol et al. 1994; Franck et al. 2002, 2006; Lorimor et al. 2008; Vigliocco et al. 1995, 1996; Wagers et al. 2009; Wilson, Nicol 1999; Yanovich, Fedorova 2006). However, almost all studies focused primarily on number agreement between the subject and the predicate. A classical English example is given in (1).

(1) *The key to the cabinets are rusty.*

The term *attraction* is used to describe the following phenomenon. The verb *are* erroneously agrees not with the head of the subject NP *key*, but with an intervening noun, or attractor, *cabinets*. Such errors frequently occur naturally and are produced in high numbers in experimental conditions. Compared to them, agreement errors without attraction, like (2), are very rare. It was also demonstrated that people tend to overlook the same agreement errors that they produce more often (Pearlmutter et al. 1999, a.o.). This tendency can be traced in reading times, in grammaticality judgment accuracy and in ERP data.

(2) *The key (to the cabinet) are rusty.*

Various syntactic, semantic and morphological factors affecting production and perception of agreement attraction errors were examined, which sheds light on the workings of the mental grammar. In particular, it was noted that in the languages with case morphology, like German, they are produced more often and cause smaller delay in comprehension if the form of the intervening noun coincides with the Nominative case form, as in (3a) compared to (3b) (e.g. Hartsuiker et al. 2003).

(3)	a.	<i>Die</i>	<i>Stellungnahme</i>	<i>gegen</i>	<i>die</i>	<i>Demonstrationen</i>	<i>waren...</i>
		ART.NOM.SG	position	against	ART.ACC.PL(=NOM.PL)	demonstrations	were'
	b.	<i>die</i>	<i>Stellungnahme</i>	<i>zu</i>	<i>den</i>	<i>Demonstrationen</i>	<i>waren...</i>
		ART.NOM.SG	position	on	ART.DAT.PL(≠NOM.PL)	demonstrations	were'

Intuitively, we can make the following conclusion: although we know on some level that the intervening noun is not Nominative, it can be mistaken for the subject. But how exactly this happens is a matter of debate. Our self-paced reading study capitalizing on particular morphological characteristics of Russian offers a novel view on this question.

In Russian, some adjective forms are ambiguous between different cases: Gen. Sg, Dat.Sg, Instr.Sg and Prep.Sg for Feminine forms, and Gen.Pl and Prep.Pl for all genders. Rusakova (2001, 2009 etc.) who studied naturally occurring errors in Russian noted several examples like (4). We decided to study such errors in detail and so far conducted two comprehension experiments¹.

- (4) *v teh razmerov*
in those.PREP.PL(=GEN.PL) size.GEN.PL

2. Experiment 1

2.1. Method

27 native speakers of Russian, aged 18–26, took part in our first self-paced reading experiment. The materials consisted of 33 sets of target sentences and 108 fillers. All target sentences contained a subject noun with a PP modifier ('N P Adj/Part N') and a verb with an object or a modifier. NPs inside these PPs were in Gen.Pl and Prep.Pl (where the adjective form is ambiguous) and in Dat.Pl used as a control condition. In every target set, the noun inside the PP was in the correct form in one sentence and in a wrong form in two others. An example is given in (5a–c).

- (5) a. *Neudachi v proshlyh sezonah zastavili*
failure.NOM.PL in previous.PREP.PL season.PREP.PL make.PST.PL
- komandu potrudit'sja.*
team.ACC.SG work.INF
- b. *Neudachi v proshlyh sezonov...*
failure.NOM.PL in previous.PREP.PL(=GEN.PL) season.GEN.PL
- c. *Neudachi v proshlyh sezonam...*
failure.NOM.PL in previous.PREP.PL(≠DAT.PL) season.DAT.PL

The resulting experimental conditions are shown in Table 1. Let us note that conditions C2 and C4 contain the errors we are interested in: the preposition requires case A, the adjective form is ambiguous between cases A and B and the noun appears in case B.

¹ It would also be very interesting to study them in production, but experimental techniques used to induce subject-predicate agreement errors are not applicable to this case, and we could not find a suitable alternative.

Table 1. Experimental conditions C1–C9²

	Prepositions taking Genitive: 11 sets	Prepositions taking Prepositional: 11 sets	Prepositions taking Dative: 11 sets
Nouns in Genitive	C1: correct form	C4: wrong form, as in (5b)	C7: wrong form
Nouns in Prepositional	C2: wrong form	C5: correct form, as in (5a)	C8: wrong form
Nouns in Dative	C3: wrong form	C6: wrong form, as in (5c)	C9: correct form

The information in the following paragraphs is also applicable to our Experiment 2, so we will not repeat it in section 3. Filler sentences contained no errors. Every subject saw one sentence from each target each set, so we had three experimental lists in Experiment 1 and six lists in Experiment 2. The number of target sentences in different conditions was balanced across lists. Every list started with five filler sentences, and then target and filler sentences were mixed pseudo-randomly (at most two target sentences with errors appeared in a row).

The experiment was run on a PC using *Presentation* software. Target and filler sentences appeared one by one and were masked. Every key press revealed a new word in a sentence and masked the previously revealed word, and RTs were measured. Comprehension questions with a choice of two answers were asked after 50% randomly selected sentences to ensure that the participants were reading properly.

We analyzed participants' question-answering accuracy and reading times. The raw reading times (per word) that exceeded 1,500 ms were adjusted to this threshold. In total, about 0,4% of the data was adjusted in Experiment 1 and about 0,6% in Experiment 2. As for question-answering accuracy, given that no participant made more than five mistakes, a breakdown of RTs into correct and incorrect question trials was not done.

2.2. Results

We compared average RTs per region in C1–C3, C4–C6 and C7–C9 (see diagrams in Fig. 1). All target sentences were 7 words long, so there were 7 regions in every sentence. There were no significant differences in regions 1–3 (before the nouns in a wrong case appeared) and in regions 6–7. I.e. the effects of violations were local, confined to regions 4–5. Average RTs in these regions are given in Table 2.

² Initially, we had 12 sets in every group, but one had to be removed due to a minor mistake in the procedure, and two sets in two other groups were removed to keep materials balanced.

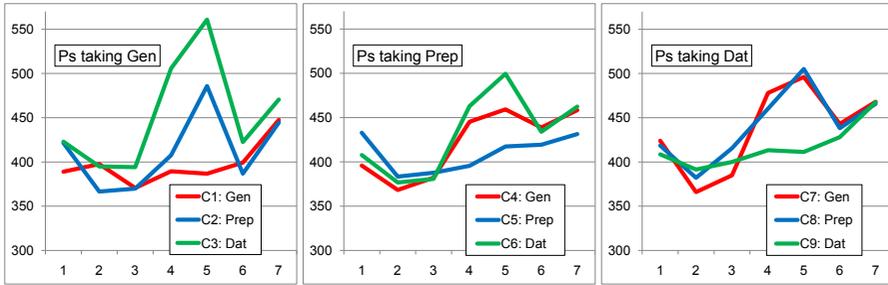


Fig. 1. Average RTs per region (in ms) in different experimental conditions

Table 2. Average RTs (in ms) in regions 4–5 in conditions C1–C9

	C1	C2	C3	C4	C5	C6	C7	C8	C9
Region 4	389.5	407.5	505.7	445.3	395.6	462.9	478.0	460.2	413.4
Region 5	386.7	485.8	560.9	459.3	417.4	499.5	496.0	505.1	411.3

In the sentences with prepositions selecting Genitive, the difference between C1 and C3 is significant both in region 4 ($F(1,52)=7,19, p=0,01; F2(1,20)=6,12, p=0,02$) and region 5 ($F(1,52)=12,26, p<0,01; F2(1,20)=15,55, p<0,01$). The difference between C1 and C2 is significant only in region 5 ($F(1,52)=6,89, p=0,01; F2(1,20)=10,180, p<0,01$). In the sentences with prepositions selecting Prepositional, the difference between C5 and C4 never reaches significance, the difference between C5 and C6 is significant in region 5 ($F(1,52)=4,14, p=0,05; F2(1,20)=5,81, p=0,03$). In the sentences with prepositions selecting Dative all errors are processed similarly. The differences between conditions are not significant in region 4, but reach significance in region 5 ($F(1,52)=7,74, p<0,01; F2(1,20)=13,34, p<0,01$ for C9 vs. C7; $F(1,52)=9,40, p<0,01; F2(1,20)=9,23, p<0,01$ for C9 vs. C8).

To conclude, in C2 and C4, where the adjective form is ambiguous between cases A and B and the wrong noun appears in case B, the slow-down associated with the errors is delayed and less pronounced in comparison with the other cases. Several hypotheses explaining this effect can be suggested. According to the first one, we forget what the case on the noun should be, try to recover it from the adjective and can make a mistake if the adjective is ambiguous. However, this hypothesis is undermined by the fact that the distance between the preposition and the noun is too short. According to the second hypothesis, it is possible to build a local syntactic structure, say, an NP, in C2 and C4, and the violation is discovered only at a later stage, when we embed this NP in a PP, while otherwise, it is visible immediately. However, this does not explain parallel mistakes in production. So we favor the third hypothesis that will be elaborated below: the phenomenon is similar to subject-predicate agreement attraction discussed in the introduction.

To compare these hypotheses, Experiment 2 analyzes how the effect we observed depends on the linear distance between the adjective and the noun. If forgetting or locality are at stake, this effect should increase or decrease, respectively, while agreement attraction phenomena are known to be independent from linear distance (e.g. Bock, Miller 1991). Finally, let us note that it is unclear why all effects are more pronounced in the sentences with Genitive.

3. Experiment 2

3.1. Method

In our second experiment, we used the same methodology as in the first one. 36 native speakers of Russian, aged 17–34, took part in it. The materials consisted of 36 sets of target sentences and 108 fillers. There were six sentences in every set, so we had six experimental lists. As before, all target sentences contained a subject noun with a PP modifier and a verb with an object or a modifier. But this time, three sentences in every set had three words inside the PP ('P Adj/Part N') and the other three had six words: the adjective or participle was followed by a three word long modifier. An example is given in (6a–b). The prepositions required Genitive case in 18 sets and Prepositional case in the other 18 sets (this time, we did not include prepositions taking Dative). In every set, the noun inside the PP was in the correct form in two sentences and in a wrong form in four others. Genitive, Prepositional and Dative case were used, as before.

- (6) a. *Listja na peshehodnyh dorozhkah / dorozhek / dorozhkam*
 leaf.NOM.PL on pedestrian.PREP.PL(=GEN.PL) path.PREP.PL path.GEN.PL path.DAT.PL
radujut zolotistym tsvetom.
 gladden.PRS.3PL golden.INSTR.SG colour.INSTR.SG
- b. *Listja na idushchih vdol' krutogo berega*
 leaf.NOM.PL on going.PREP.PL(=GEN.PL) along steep.GEN.SG bank.GEN.SG
dorozhkah / dorozhek / dorozhkam...
 path.PREP.PL path.GEN.PL path.DAT.PL

The resulting experimental conditions are shown in Table 3. Conditions C2, C4, C8 and C10 contain the errors we are interested in: the preposition requires case A, the adjective form is ambiguous between cases A and B and the noun appears in case B.

Table 3. Experimental conditions C1-C12

	Prepositions taking Genitive: 18 sets		Prepositions taking Prepositional: 18 sets	
	‘Short’ conditions	‘Long’ conditions	‘Short’ conditions, as in (6a)	‘Long’ conditions, as in (6b)
Nouns in Genitive	C1: correct form	C7: correct form	C4: wrong form	C10: wrong form
Nouns in Prepositional	C2: wrong form	C8: wrong form	C5: correct form	C11: correct form
Nouns in Dative	C3: wrong form	C9: wrong form	C6: wrong form	C12: wrong form

3.2. Results

We compared average RTs per region in C1–C3, C4–C6, C7–C9 and C10–C12 (see diagrams in Fig. 2). The effects of the violations were local, as in Experiment 1. Target sentences contained 7 words in the short conditions and 10 words in the long conditions. In the short conditions, significant differences were confined to region 4 (where the noun in the wrong case appears) and 5. Average RTs in these regions are given in Table 4. In the long conditions, there were significant differences only in region 8 (following the region where the noun in the wrong case appears). Average RTs in this region are given in Table 5.

Table 4. Average RTs (in ms) in regions 4–5 in conditions C1–C6

	C1	C2	C3	C4	C5	C6
Region 4	365.4	419.9	439.8	381.7	372.6	402.5
Region 5	384.7	476.0	511.5	450.0	397.6	475.3

Table 5. Average RTs (in ms) in regions 4–5 in conditions C7–C12

	C7	C8	C9	C10	C11	C12
Region 8	366.6	417.8	459.4	417.4	394.3	431.3

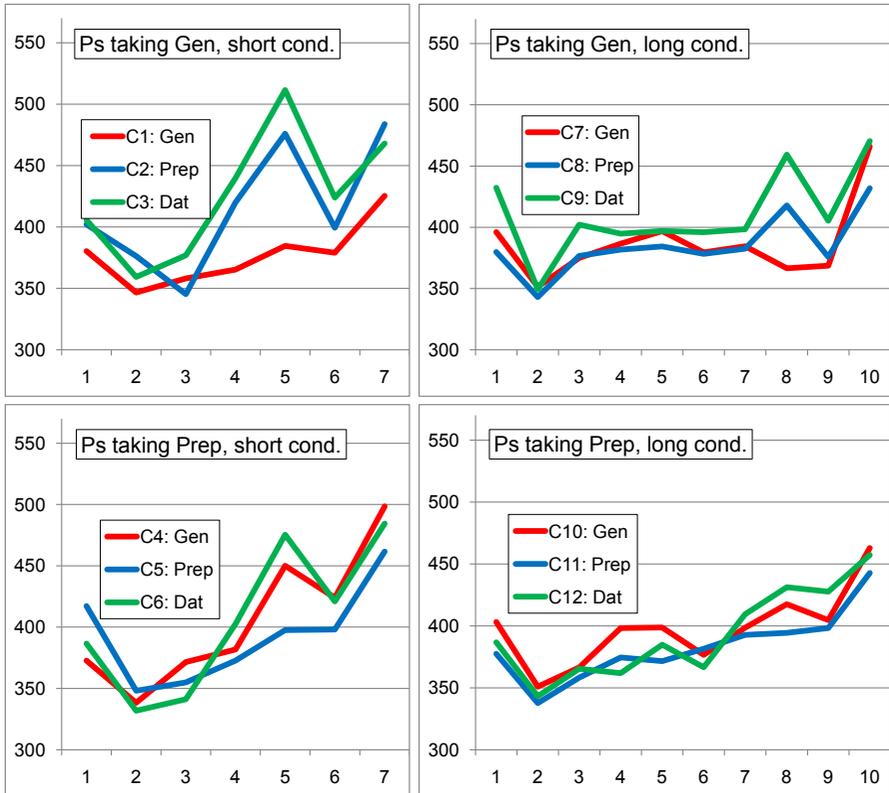


Fig. 2. Average RTs per region (in ms) in different experimental conditions

In the short conditions, the results were the same as in Experiment 1. In the sentences with prepositions selecting Genitive, the difference between C1 and C3 is significant both in region 4 ($F(1,170)=4,01$, $p=0,05$; $F(1,34)=6,96$, $p=0,01$) and region 5 ($F(1,170)=9,15$, $p<0,01$; $F(1,34)=10,05$, $p<0,01$). The difference between C1 and C2 is significant only in region 5 ($F(1,170)=7,67$, $p=0,01$; $F(1,34)=8,11$, $p=0,01$). In region 4, it approaches significance ($F(1,170)=3,06$, $p=0,08$; $F(1,34)=4,11$, $p=0,05$). In the sentences with prepositions selecting Prepositional, the difference between C5 and C4 never reaches significance, while the difference between C5 and C6 is significant in region 5 ($F(1,170)=4,53$, $p=0,04$; $F(1,34)=5,65$, $p=0,02$).

Now let us turn to the long conditions. In the sentences with prepositions selecting Genitive, in region 8 the difference between C7 and C9 is significant ($F(1,170)=10,92$, $p<0,01$; $F(1,34)=11,12$, $p<0,01$) and the difference between C7 and C8 approaches significance ($F(1,170)=3,24$, $p=0,07$; $F(1,34)=4,93$, $p=0,03$). In the sentences with prepositions selecting Prepositional, there are no significant differences in any region.

4. General discussion and conclusions

In total, the effects of all violations are less pronounced and delayed in the long conditions. This is expected: numerous studies demonstrate that readers' ability to detect errors degrades when the syntactic complexity increases. But the difference between two types of errors is visible both in the short and in the long conditions. The errors our study focuses on (the preposition requires case A, the adjective form is ambiguous between cases A and B and the noun appears in case B) are detected later and cause smaller delays than the other errors. For the sentences with prepositions selecting Genitive, this can be proved statistically in Experiments 1 and 2 both in short and in long conditions. In the sentences with prepositions selecting Prepositional, no differences reached significance in the long conditions, but average RTs show the same tendency as in the short conditions in Experiments 1 and 2: in regions 7–9, they are longer in the sentences with Dative nouns than in the sentences with Genitive nouns.

The fact that the observed effect does not depend on linear distance supports the hypothesis that it is similar to agreement attraction. Notably, only one of the existing approaches to attraction, the one advocated by Wagers et al. (2009), can be extended to our case. According to this approach, when a wrong form is produced or encountered (a wrong number on the verb or a wrong case in ours), the speaker or reader comes back to recheck the structure, and certain things may interfere with this process (an attractor noun or an adjective or participle ambiguous for case). Most other authors assume a different mechanism of agreement attraction: the subject NPs erroneously inherits its number or other features from a dependent NP rather than from its head. However, this mechanism is inapplicable to the structures we study.

One of the most important questions is how ambiguous forms are represented so that errors become possible. In comprehension, morphological ambiguity should be resolved by the time the verb or the noun in the wrong form appears. In production, we should know from the very start which case the ambiguous form bears. The fact that errors arise in production and go unnoticed in comprehension nevertheless suggests that morphologically ambiguous forms are deeply interconnected and potentially share some syncretic representation, as it was first suggested by Jakobson (1936). Some of the modern morphological theories adopted this idea, the others did not. Evidently, experimental data can be used to support the former approach.

Finally, in Experiment 1 all effects were more pronounced in the sentences with Genitive. This was also the case in Experiment 2, both in the long and in the short conditions. Thus, this can hardly be accidental, but so far, we have no explanation for this finding.

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