CHAPTER FOURTEEN

PHENOMENON-SENSITIVE SENTENCE PROCESSING IN NATIVE SPEAKERS AND LANGUAGE LEARNERS

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Native-like cross linguistic variation in attachment resolution of relative clauses (RC) is not preserved in the second language (L2). Native speakers (NS) of Russian switch to English-like RC resolution in the L2-English. NSs of English show the equivalent tendency in their L2-Russian. If bilinguals are tested in their L1s, there is no difference in interpretation decisions with the respective monolingual groups. When there is a linguistic phenomenon that facilitates a certain RC interpretation, both monolinguals and non-balanced adult bilinguals are sensitive to it. The effect of a linguistic cue is solid in English, but it does not fully explain RC resolution preferences in Russian. The study found no lexical effect in linguistic decision making. Both monolinguals and non-balanced bilinguals use similar syntax-based processing strategies.

1. Introduction

The current paper reports an experimental study of the processing strategies applied by native speakers (NS) and language learners for complex syntactic strings in their native and non-native languages. The study uses relative clauses (RC) with ambiguities and investigates how the placement of a perception verb in the matrix clause changes RC interpretation. The study is focused on the differences in RC interpretation in Russian and English and the fact that a matrix verb may account for them. The experiment checks whether both NS and language learners of Russian and English are equally sensitive to the grammatical phenomenon of the perception verb in their native and non-native languages.

The linguistic target of the study is a complex sentence containing the RC with ambiguity, like in (1):

(1) Maria arrested [$_{NP}$ the mother of the woman] [$_{CP}$ that was talking about cosmetics].

In sentence (1) the relative clause (RC) *that was talking about cosmetics* can be interpreted in two ways: to modify the noun *mother* or the noun *woman*. The two answer choices yield two grammatically possible answers to the comprehension question in (2):

(2) Who was talking about cosmetics?
a) the mother b) the woman

As established by Fodor (2002), all syntactic properties being balanced, NSs of Russian, French, Dutch, German, Greek, and Italian interpret the RC in (1) (*that was talking about cosmetics*) to modify the higher noun *mother* in the complex head NP *the mother of the woman*, whereas, NSs of English, Norwegian, Romanian, and Swedish assign the RC to the lower noun *woman*.

In terms of syntactic analysis, NSs of Russian, French, Dutch, German, Greek, and Italian choose high attachment (HA), as their preferred interpretation. In these languages the RC modifies the higher noun in the syntactic tree. NSs of English, Norwegian, Romanian, and Swedish prefer low attachment (LA) and syntactically the RC modifies the lower noun in the tree.

In modular approaches to sentence processing, LA is viewed as a universal parsing preference (Frazier and Rayner 1982).[1] LA is a straightforward outcome of the application of the two basic processing principles: the Late Closure (LC) and the Minimal Attachment (MA). If the LC is applied, the incoming information is attached to the existing syntactic node for as long as possible. If attachment is impossible a new minimally-needed node is projected. The latter is an example of how the MA works.

The established cross-linguistic variation in RC-attachment resolution shows that the universal preference for LA is overridden in Russian, French, Dutch, German, Greek, and Italian. Many linguistic approaches tried to explain why. For example, the Implicit Prosody Hypothesis (IPH) points out that the prosodic structure of the RC varies from language to language

[1] See also, Frazier, and Fodor (1978); Frazier, and Clifton (1997) and Fodor (1998).

and entails cross-linguistic variation in RC resolution (Fodor 2002). This hypothesis influenced the field of second language (L2) research.

Another significant hypothesis is the pseudo-relative (PR)-first hypothesis by Grillo and Costa (2014). The authors claim that the perception verb in the matrix clause triggers a certain syntactic projection that facilitates HA. It is called an event-oriented interpretation of the RC, or a PR reading. For an event-oriented interpretation, the RC modifies the matrix verb, not the head nouns in the sentence. In English the closest syntactic equivalence to the PR is the Small Clause (SC).

(3) Maria saw (*what*?) [SC the mother of the woman talking about cosmetics]. (PR equivalent in English)

The described projection is one of the default RC interpretations in French, Spanish and Italian, which explains HA preference by NSs of these languages (Grillo and Costa 2014). The relevance of the PR-first hypothesis for the current study is explained in the next section.

The studies on L2 processing develop the findings by the IPH and claim that non-balanced adult bilinguals show target language (TL)-like attachment resolution even at the lower levels of L2 proficiency. For example, Dekydtspotter et al (2008) claim that L2-learners are sensitive to the prosodic structure of French. Non-balanced bilinguals, L2 learners of French, whose native language (NL) is English, follow the prosodic cues of the L2 French and switch to the TL-like HA in French. The current study expands the findings by Dekydtspotter et al (2008) in L2 speakers and tests non-balanced bilinguals for the sensitivity to syntactic phenomenon of the perception verb, as suggested by Grillo and Costa (2014).

One of the most influential hypotheses in the field of L2 processing is the Shallow Structure Hypothesis (SSH). It claims that L2 speakers process their L2 differently from monolinguals. Following the SSH, L2 speakers rely on lexical and discourse information more than on syntax. Thus, they make interpretation decisions in the L2 based on the lexical information and afterwards build a relevant syntactic representation to process the sentence (Clahsen and Felser 2017).

The current study employs the assumptions of the PR-first hypothesis and the predictions of the SSH in the two-by-two design. In doing so, the experiment tests a syntax-first approach to L2 processing against the lexical processing hypothesis in an experiment with non-balanced bilinguals. The paper provides a theoretical overview of the PR-first hypothesis by Grillo and Costa (2014). The theoretical assumptions are followed by research questions (RQ) and hypothesis. A full account of the experiment comes

next. In conclusion the paper discusses the impact of the experimental results for research in language acquisition and language processing.

2. The PR-first hypothesis

The PR-first hypothesis was originally introduced to Romance languages, like French, Spanish and Italian by Grillo and Costa (2014). Its purpose was to give account for the HA preference for RC resolution by NSs of these languages. The main claim of the authors is the following: when there is a non-perception verb in the matrix clause, only a restrictive RC reading is possible.The restrictive RC reading yields only two possible interpretations, HA or LA, as shown in (1). The perception verb *saw* changes the interpretation options and adds a PR-reading to the string that looks identical to the RC in French, Spanish and Italian, (4):

(4) Mary a écouté [SC **la mère de la femme** qui parlait de cosmétiques]. (French, PR-reading).
Mary heard the mother of the woman who talked about cosmetics.

In French, Spanish and Italian the PR reading is the third default interpretation added to the RC string by the placement of a perception verb in the matrix clause. In these languages, the PR interpretation is reached through a covert derivation of a syntactic projection, where the subordinate clause modifies the matrix verb.

In English, the PR reading is impossible without a covert change of structure. Please, compare (1) and (3), repeated here as (5) and (6).

(5) Maria arrested [NP the mother of the woman] [CP that was talking about cosmetics].
(6) Maria saw (*what*?) [SC the mother of the woman talking about cosmetics].
Maria saw the event of talking about cosmetics performed by the mother of the woman.

The example in (5) is a restrictive RC that is ambiguous between the interpretation decision towards either HA or LA. The example in (6) is an event-oriented interpretation, which is equivalent to the PR reading in French, Italian and Spanish.

In English the subordinate should have a form of the SC for the event-oriented interpretation. Meanwhile, if a perception verb triggers a mental projection for an event-oriented interpretation, it should facilitate HA in

English, as well. As shown in (6), in the event-oriented interpretation only the higher noun *mother* can be the doer of the action of talking. The LA interpretation equivalence is ungrammatical in the event-oriented interpretation triggered by the perception verb *saw*. As a consequence, the placement of the perception verb in the matrix clause should switch the overall preference in NSs of English from LA to HA.

Alongside English, the study also uses Russian, creating an interesting set of experimental options. Based on the availability of a PR reading, i.e. when no covert change of structure occurs, languages can be classified as PR- and non-PR. From the explanation above, it follows that French, Spanish, and Italian belong to the group of PR-languages. At the same time, languages like Russian and English belong to the non-PR group. In Russian, the same as in example (6) above, an event-oriented interpretation is impossible from the regular RC string. Both target languages of the experiment are non-PR languages.

Grillo and Costa (2014) do not predict any parsing differences between the non-PR- and PR-languages. A possible explanation is that everything else being equal, the parser will choose the PR interpretation over the restrictive one. The PR interpretation is claimed to be easier for processing because the perception verb immediately triggers a projection to modify itself. On creating the projection of the matrix verb, the parser does not need to wait until the entire fragment is processed to assign the elements to their heads retrospectively (Grillo and Costa, 2014).

The assumption for no difference between the PR- and non-PR languages receives additional support in a study of attachment resolution preferences in NSs of English, conducted by Grillo et al (2015). The experiment reports a strong HA preference for RC attachment resolution under the influence of the perception verb in the matrix clause. The effect of the verb is equally strong when the target clause is in either Nominal or Verbal positions.

Following the findings by Grillo et al (2015), the current experiment expects to see the effect of the verb in both English and Russian. A swap to HA under the influence of the perception verb in the matrix clause is called a phenomenon-sensitive type of sentence processing.

The current study does not support the claim by the SSH that NSs and L2 learners process languages differently. The study expects to see phenomenon-sensitive sentence processing in L2 speakers, i.e. the effect of he perception verb should be equally strong for both NSs and non-balanced bilinguals. The effect of the verb influences L2 speakers in both the NL and the L2.

The study also double-checks for the language specific RC-attachment resolution preferences. In this respect, Russian and English belong to different attachment resolution groups: Russian is a HA-language and English is a LA one. The overall preference for a certain type of RC resolution should be preserved in the monolingual groups. Following the author's assumption that NSs and non-balanced bilinguals use the same processing strategies, the experiment expects L2 speakers to show TL-like attachment resolution in the L2.

3. Research questions and hypotheses

The ***overarching Research Question (RQ)*** of the study is whether a perception verb in the matrix clause facilitates HA in all the groups of participants, independently of the language specific RC-attachment resolution preferences.

The ***general hypothesis*** claims that all the groups of participants show processing sensitivity to the linguistic phenomenon of the perception verb.

To provide a full account for the effect of the perception verb on RC processing, the study breaks down the overarching RQ into a set of specific RQs.

RQ1: Does a perception verb in the matrix clause change the RC interpretation pattern towards HA in NSs of English?

Hypothesis 1 to RQ1: NSs of English switch to HA resolution of the RC under the influence of a perception verb in the matrix clause.

RQ2: Does a perception verb in the matrix clause facilitate HA in NSs of Russian?

Hypothesis 2 to RQ2: A perception verb in the matrix clause ensures HA in NSs of Russian. Russian is a HA language with all predicates.

RQ3: Does a perception verb in the matrix clause shape the RC interpretation in the L2 of language learners?

Hypothesis 3 to RQ3: In their L2, language learners are sensitive to the effect of the perception verb and choose HA under its influence.

RQ4: Does a perception verb in the matrix clause shape the RC interpretation in the L1 of language learners?

Hypothesis 4 to RQ4: A perception verb in the matrix clause facilitates HA in the NL of L2 speakers.

RQ5: Do NSs rely on lexical information for RC attachment resolution?

Hypothesis 5 to RQ5: NSs of Russian and English do not follow the gender and social biases for their interpretation decision. They show syntactic processing and do no rely on lexical information.

RQ6: Do L2 speakers use lexical information for RC resolution in their L2?

Hypothesis 6 to RQ6: L2 speakers show syntactic processing in the L2, lexical information is not their first processing aid.

4. The study

4.1 Design

The study is designed as a two-by-two experiment and manipulates the verb type in the matrix clause and the lexical biases in RC interpretation. The verb type condition is a perception vs. a non-perception matrix verb.

The lexical condition is derived from the traditional perceptions of gender roles and social biases of what men and women might do. In the case of lexical processing the participants will attach the RC to either a male or a female head noun. If the gender of the head nouns shapes attachment resolution preferences, it means that the participants rely on lexical meaning of the words to generate appropriate syntactic projections to process the sentences, as predicted by the SSH.

A sample stimuli quadruple is provided below:

a) Maria **saw** *the mother of the man* that was talking about soccer.
b) The police arrested *the mother of the man* that was talking about soccer.
c) Maria **saw** *the mother of the man* that was talking about cosmetics.
d) The police arrested *the mother of the man* that was talking about cosmetics.

In the sample stimuli set, examples (a) and (b) use the RC that is lexically biased towards the masculine noun in the complex head NP *the mother of the man*. They are counter-balanced by the examples (c) and (d), where the RC can be biased towards the feminine noun in the head NP.

The perception matrix verb in (a) and (c) is counter-weighed by the non-perception verb in (b) and (d). The target sentences are balanced across conditions and for the order of answer choices. The gender-biased conditions were created based on the surveys conducted among the NSs of Russian and English.

To keep the stimuli sets balanced between Russian and English, the experiment uses animate head nouns, whose biological gender speaks for itself. The grammatical gender is overtly marked in Russian and is unmarked in English. This difference between Russian and English is relevant for the current experimental.

English has a notional gender**,** there is no overt morphological marking for grammatical gender. In the experiment, the head nouns belong to different biological genders and the action of the RC is assigned to be fulfilled either by men or by women. The social gender roles were assigned based on the results of a survey taken among the students of a mid-western American University.

In Russian, grammatical gender is overtly marked. The relative pronoun is also marked for gender. To keep the sentence ambiguous, both nouns should be of the same grammatical gender. For this reason, in the Russian stimuli set a possible choice for attachment resolution lies between social statuses, for example, children-parents. These quadruples were created based on a survey taken among adult Russian native speakers in Russia.

A sample stimuli quadruple for Russian is provided below:

a) Maria **saw** *the grandson of the man* that was plating with a kitten.
b) The police arrested *the grandson of the man* that was plating with a kitten.
c) Maria **saw** *the grandmother of the girl* that was plating with a kitten.
d) The police arrested *the grandmother of the girl* that was plating with a kitten.

By the results of the survey, in (a) and (b) the RC is most likely to be assigned to the higher noun *grandson* and in (c) and (d) to the lower noun *girl*. The verb type is not influenced by the cross-linguistic differences. The same as in the English stimuli, (a) and (c) have a perception verb in the matrix clause, (b) and (d) have the non-perception one.

The full stimuli set contains 40 target sentences and 40 distractors. The distractors are complex syntactic strings that do not contain subordinate RCs and do not offer ambiguous structures for interpretation decisions. All the sentences are jumbled up by the program Linger and every participant has a different random order of the sentences.

4.2 Participants

The participants of the study form 6 groups: NSs of Russian (NR), NSs of English (NE) and four groups of non-balanced bilinguals. The learners of Russian are divided into two sub-groups, the 1st sub-group was tested in Russian, which is the L2 for the participants, and the 2nd sub-group was tested in English, the L1 for the participants. There are also two groups of L2 learners of English, who were also tested in their L1 Russian and their L2 English, respectively.

The groups were assigned randomly. The way the participants were split into groups allows for the investigation of processing preferences comparing monolinguals to bilinguals and bilinguals to each other differentiating them by the language of testing.

The profiles of the participants were balanced. The mean age of the participants is 21 in the L2 Russian group and 29 in the L2 English group. Both groups of unbalanced bilinguals have a similar amount of hours of exposure to their L2 per week. In the language proficiency measure, a C-test, the L2 speakers of Russian did 37% of the task correct, range 46. The L2 speakers of English showed the result of 46% correct, range 40. There are no statistically significant differences between the L2 groups, $F (1, 20) = .749$, $p = .739$.

4.3 Experiment

The experiment of the study is a self-paced reading task administered through a software platform for linguistics experiments Linger. The participants read a set of sentences on the screen and answered a comprehension question after every sentence. The participants can only see one word on the screen at a time. To retrieve the next word a participant must click the SPACE bar. There is no "return" option. After every sentence a participant sees a comprehension question and two possible answers on the screen. The answer choice is made by clicking either on the letter "F" or "J". To choose the answer on the left a participant should click the button on the left, which is "F". To choose the answer on the right, the button "J" should be used.

Data analyses was performed with the software package for SPSS using the Mixed Linear Model. All the results of the study are presented with HA as the reference category.

5. Results

To answer the RQs of the study the analyses checked for the effect of the perception verb (Verb Type), the effect of the group (Group Effect) and the effect of gender and social biases (Lexical Effect) on the RC attachment resolution. To measure the effect of these linguistic factors the dependent variable is the answer choice to comprehension questions (Nchoice).

The analysis showed no Lexical Effect on RC attachment resolution in any group of participants. The $F (1;2433) = 1,363$; $p = .243$. The F-statistics shows that RQs (5) and (6) receive a negative answer supporting the hypothesis that both NSs and language learners rely on syntactic

information in sentence processing, rather than follow lexical clues to build relevant syntactic projections.

The Verb Type factor shows an overall significant effect of the perception verb on RC resolution. F (1;43) = 4, 4778; p = .034. The effect of the perception verb is the same for every group of participants because there is no correlation "Group*Vtype". These data allow for the preliminary conclusion that the role of the perception matrix verb in RC resolution is significant. RQs (3) and (4) receive affirmative answers. Meanwhile, to answer RQs (1) and (2), a pairwise comparison between groups is needed.

The experiment returns a highly significant Group Effect, F (5; 2433) = 47.464; p = .0001. There is a distinctive overall difference in attachment resolution between the two monolingual groups. With both predicates, NSs of Russian prefer HA in 67 % of the cases and NSs of English prefer LA in 27 % of the cases.

The bilingual groups, tested in the L1, either do not show any significant difference from the NSs of the corresponding language (English) or show even a stronger preference for the L1-like attachment resolution (Russian). L2 Russian group, tested in English (their L1) prefers HA in 32 % of the cases. L2 English group, when tested in their L1 Russian, choose HA 77% of the time. Monolinguals show no difference from bilinguals, when bilinguals are tested in their L1.

Both bilingual groups, tested in the L2, show a tendency for TL-like attachment resolution. L2 learners of English choose HA 57 % of the time in English, which is significantly lower than in their NL, Russian. L2 learners of Russian tend to prefer HA in the L2 more often than in their NL, English. They choose HA 50 % of the time on average.

The effect size of both the Group Effect and the Verb Type Effect is presented as the ratio of odds. There is a big difference between the two monolingual groups: the odds for choosing HA is 5.58 times greater in NSs of Russian than in NSs of English. Russian-English bilinguals tested in the L1 are 2.78 times more likely to prefer HA than NSs of English. English-Russian bilinguals, tested in the L1, choose HA twice as often as NSs of English but NSs of Russian choose HA twice as often as them. When tested in the L2, Russian-English bilinguals choose HA 1.32 times more often than English-Russian bilinguals. For the Verb Type Effect, the odds of choosing HA is 1.32 times greater when the matrix verb is a perception verb than with a non-perception verb.

6. Discussion

Even though the general hypothesis of the study is supported and a perception verb in the matrix clause favors HA resolution, the findings of the experiment should be commented on. The discussion section follows the order of RQs.

The most important results show that the speakers of both HA and LA languages limit their RC resolution preference to HA when there is a perception verb in the matrix clause. NSs of English switch to HA (RQ1) under the influence of the matrix verb. NSs of Russian do not show HA preference 100 % of time, but in the sentences with a perception verb, they show consistent preference for HA (RQ2). The perception verb facilitates HA in monolingual speakers of high and low-attachment languages.

The verb influences all the groups of the participants in the same way. In the L2, both bilingual groups prefer HA in the sentences with a perception verb in the matrix clause (RQ3). The effect of the matrix verb is the same in the L1 of the bilinguals (RQ4).

An interim conclusion is that the effect of the perception verb in the matrix clause is significant for RC attachment resolution. Speakers of two non-PR languages, English and Russian, are sensitive to the linguistic phenomenon of the perception verb. The PR- first hypothesis of Grillo and Costa (2014) receives experimental evidence from this study. The ***overarching RQ*** of the study receives an affirmative answer and the *general* ***hypothesis*** of the study is confirmed.

Meanwhile, the Group Effect deserves an additional comment. The overall difference in attachment resolution between the two monolingual groups supports the claim by Fodor (2002) that languages are divided into HA- and LA-languages. Russian and English belong to different attachment resolution groups, as in English the overall RC resolution preference is LA and in Russian HA is preferred with both predicates.

In the analysis of the results of the bilingual groups, the Group Effect equals the effect of the language of testing. Both bilingual groups were split in halves and tested in their L1 and L2, respectively. The Group Effect shows that the language of testing is crucially important for RC attachment resolution. Among the 4 groups of unbalanced bilinguals, the groups that were tested in the L1 show L1-like attachment resolution preferences, the groups that were tested in the L2, show a tendency to the L2-like attachment resolution preference.

The most straight-forward conclusion for the bilingual participants is that having two languages in the brain does not change the speakers processing strategies. Processing strategies are language-specific and

phenomenon-sensitive in bilinguals, the same as in monolinguals. In the experiment the language of testing imposes parsing mechanisms that the learners are sensitive to.

Unlike the monolingual results in English from Grillo et al (2015), the effect of a perception verb does not change the overall attachment resolution preference in English. In Russian, the subjects are sensitive to the effect of the perception verb, but it does not exhaustively explain the HA preference in Russian, Russian is a HA-language on its own.

The study does not show any Lexical Effect in RC attachment resolution, which gives a negative answer to RQs (5) and (6). It is unlikely that the subjects rely on the lexical meaning of the words to generate an appropriate syntactic structure and process the sentence. Together with the sensitivity to the effect of the perception verb, the result of no Lexical Effect speaks against the predictions of the SSH and in favor of syntax-based processing models.

7. Conclusions

The study found evidence for phenomenon-sensitive sentence processing in monolinguals and bilinguals at early stages of L2 acquisition. The perception verb is a linguistic phenomenon that favors HA of the ambiguous RC.

Monolingual and bilingual speakers of non-PR languages are sensitive to the effect of the perception verb and follow its prompt to override the universal preference for LA. The effect of the verb is strong for the languages that belong to different attachment resolution groups. Meanwhile, the perception verb is not the only factor that entails HA preference in languages, like Russian.

The data of the Group Effect shows that languages are legitimately divided into high- and low-attachment ones. In the context of a cross-linguistic variation, bilingual participants show a language-specific processing pattern.

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