A Different Type of RC Attachment Resolution: Comparing Bilingual versus Trilingual Processing

Abstract: This study uses a self-paced reading experiment (Linger) to investigate how attachment resolution of ambiguous relative clauses (RC) changes depending on the language of testing, social convention biases, and a linguistic effect of the matrix verb (perception, non-perception). Native speakers confirm the pattern of cross-linguistic variation in RC resolution: high attachment in Russian and low attachment in English. Both L2 and L3 speakers of Russian and English demonstrate significant development towards the target-language-like preferences. A perception matrix verb facilitates high attachment in all L2 and L3 groups, just as in monolingual controls. In sum, non-native processing appears to be sensitive to syntactic cues and complex attachment preferences can be acquired successfully in a second and third language.

Key words: non-native processing, bilingual, trilingual parsing, structural, top-down, projection, bottom-up.

1. Introduction

The study reported in the paper approaches non-native processing from a developmental perspective and aims at describing its specific characteristics at the intermediate level of proficiency. The chapter takes a special interest in checking whether there are processing differences when a language is acquired as an L2 or an L3 at the intermediate level. Processing studies at the intermediate level of non-native proficiency are not numerous. Even less is known about processing mechanisms in L3. However, processing in non-native languages, be they L2, L3 or L*n*, is very likely to use similar strategies; if this turns out to be the case, then the known facts about L2 processing would prove generalizable for the entire field of non-native processing, understood more broadly.

Our special interest in investigating intermediate speakers of English and Russian is motivated by a scholarly need for a detailed step-by-step description of how the mechanism of non-native sentence processing changes with a speaker's growth in L2/L3 (further L*n*) proficiency. The intermediate level is quite an early post-initial stage of L*n* acquisition, when the parser is accumulating linguistic information from the input and is organizing it into L*n*-specific norms within the existing grammar (Schwartz & Sprouse, 1996; Fodor, 1998; Ionin, 2004; Ionin et al.

2006; Dekydtspotter, Schwartz & Sprouse, 2006; Slabakova & Montrul, 2008; Lardiere, 2009, among many others). This developmental stage of L*n* acquisition should manifest itself in sentence processing.

Processing at the intermediate level of L*n* proficiency can show whether the parser is already capable of spotting a structural cue and shapes sentence parsing accordingly (Dekydtspotter et al., 2008; Sokolova and Slabakova 2019). At the same time, there can be a strong influence of the previously learnt languages in interpretation decisions in the L*n* (Schwartz & Sprouse 1996). Besides, it is possible that the parser can distance itself from all structural peculiarities of previously acquired languages and rely on salient non-structural information to process a sentence for comprehension (Clahsen and Felser 2018). Our experimental project addresses all of these possibilities.

In the experiment we report on here, L2 speakers of English and Russian and L3 speakers of English participated in a self-paced reading study administered through software for psycholinguistics experiments Linger. They read a set of sentences at their comfortable speed and answered a comprehension question after every sentence. The program recorded their answer choices. The results of the experiment were analyzed in R.

To anticipate the findings, the study shows that social conventional information does not play any role in non-native sentence processing at the intermediate level of proficiency. Both L2 and L3 speakers of English and Russian rely on a structural parse of the linguistic signal. All non-native speakers were sensitive to a linguistic prompt at the beginning of the sentence and adjusted their parsing accordingly. Besides, non-native speakers at the intermediate level of proficiency showed a clear tendency to switch their interpretation pattern to the target-like one.

2. Theoretical Motivation

The study investigates attachment resolution of ambiguous RCs in English and Russian and uses its cross-linguistic variation to check whether non-native speakers of these languages process the RC as in their native language[1], or if they are sensitive to a linguistic prompt at the beginning of the sentence and parse the sentence accordingly. The participants may also use social conventions as their main cue to interpret the target sentences.

[1] For L3 speakers of English L1 effect in RC resolution is non-distinguishable from the effect of the L2. The choice of languages is deliberate and is explained in the section on Participants.

To start with, the structural ambiguity of the RC in (1) makes both answers to the comprehension question in (1) grammatical. In linguistics terms, option (a) is a result of high attachment (HA) of the RC, generally preferred in Russian. Option (b) results from a syntactic modification towards a lower noun (LA) which is mostly preferred in English (see Fodor 2002 for a summary).

(1) Bill saw the mother of the boy that was talking about cosmetics in the yard.

Who was talking about cosmetics?

a. the mother b. the boy

In the target sentence in (1), RC resolution can have a language-specific pattern and the study checks whether non-native speakers at the intermediate level of proficiency are sensitive to the attachment preference of the target language (TL). Adjustment towards TL-like preference in RC resolution means that the parser builds a certain mental structural description of the sentence (Phillips 1996) that favors HA in Russian and LA in English.

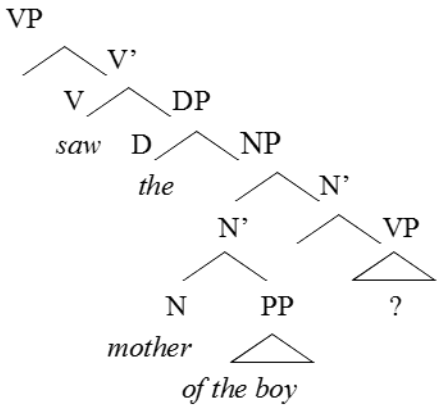
There are at least two possible accounts of non-native language processing. One proposal is that this process is dependent on correctly-analyzed and interpreted linguistic structure. Structural processing of RCs in non-native speakers of the intermediate level of L*n* proficiency was studied by Dekydtspotter et al. (2008, see Sprouse, 2011; Cunnings, 2017 for proposals on non-native processing). The study shows that intermediate speakers of L2-French are sensitive to the default prosodic differences between French and their L1-English. According to the authors, different placement of prosodic breaks in French and English entails different mental structural descriptions of the ambiguous RC, HA in French and LA in English. The participants' sensitivity to the prosody of the target language shows in their interpretation preferences for HA in French. At the same time, LA is preferred in the participants' native language – English.

The experiment in this paper extends the findings of Dekydtspotter et al. (2008) and checks whether the same sensitivity to the interpretation preferred in the TL will be replicated in non-native Russian and non-native English. Besides, our study investigates the participants' sensitivity to a perception verb (such as *see*) in the matrix clause that has a universal effect to favor HA of the RC (Grillo & Costa, 2014).

Why does this happen? According to Grillo and Costa, perception verb triggers a structural anticipation for an eventive complement like *Bill saw (what?)* the event of *talking about cosmetics* performed by the mother of the boy (2).

(2) Bill saw [$_{SC}$ the mother of the woman talking about cosmetics in the yard].

[$_{S}$ NP [VP [SC]]]

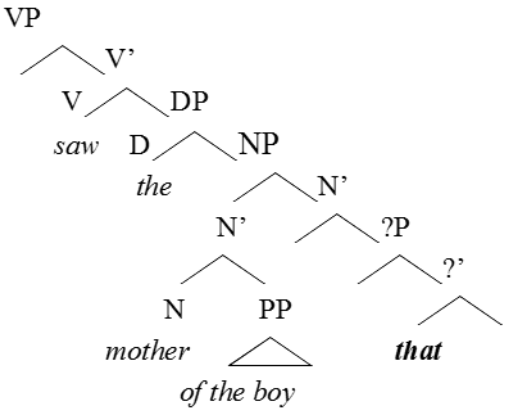


In the case of eventive interpretation, the structural modification of the subordinate clause towards the matrix predicate changes and *the mother* becomes the only grammatically licensed doer of the action of *talking*. Grillo and Costa (2014) propose that a perception verb *see* in the matrix clause in (1) has a cross-linguistic effect to favor HA of the RC. The first noun is preferred as the attachment position, and this reading exists in the mental grammar alongside the RC reading.

The effect of a perception verb on RC resolution received experimental evidence from Grillo et al. (2015) and from Sokolova and Slabakova (2019). Grillo et al. (2015) tested monolingual speakers of English. Their participants changed the English-like preference for LA to HA when the sentences had a perception verb in the matrix clause. Sokolova and Slabakova (2019) checked the effect of a perception verb with native and non-native speakers of English and Russian. A perception verb prompted a change to HA in English and maintained HA in Russian. Non-native speakers followed the structural prompt of a perception verb in the same way as monolinguals.

Readjustment of the RC interpretation towards HA after a perception verb means that the parser generates a structural projection for an eventive complement in (2). This structural projection stays valid till the complementizer is processing and shapes RC resolution (3).

(3) Bill [$_{VP}$ saw [$_{DP}$ the mother of the boy [$_{?P}$ that…]]]



This chapter continues this line of investigation, looking for an effect of a perception verb in non-native processing of Russian and English. In addition, if such an effect is established, it provides information about the directionality of mental structure building. If a projection generated at the level of the matrix predicate *see* shapes RC resolution, this means that sentence parsing is governed by a structural anticipation for an eventive complement that is not completely abandoned till the end of the sentence (see Phillips & Schneider 2000 for detail).

The second account proposes that sentence processing is guided by non-structural information (Clahsen and Felser 2018), and sentence parsing is performed in a bottom-up manner (Felser, 2018, personal communication). As argued by the Shallow Structure Hypothesis (SSH, Clahsen & Felser, 2018), non-native speakers have trouble building mental structures in online processing. Therefore, non-native processing is primarily governed by non-structural information that allows the parser to interpret a sentence. The structural model of the sentence is built at the next stage of parsing and its purpose is to ensure a grammatical fit for the incoming string of words in accordance with the formed interpretation.

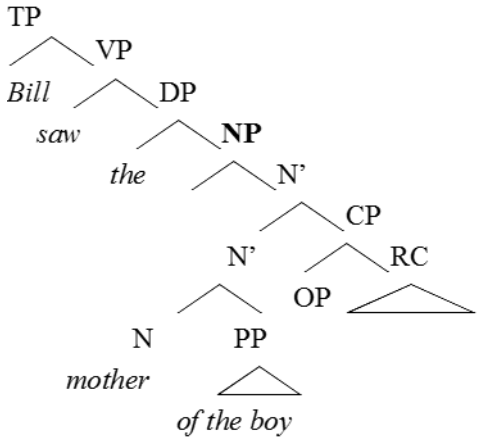
The SSH received experimental support in the studies by Felser, Roberts and Marinis (2003), Papadopoulou and Clahsen (2006), Felser and Cunnings (2012), among others. These

studies compared native and non-native processing and attested several behavioral differences. For example, advanced non-native speakers in Papadopoulou and Clahsen (2006) did not show a clear preference in RC resolution and performed at chance, whereas native speakers manifested their respective language-specific patterns of RC resolution. In an eye-tracking study by Felser and Cunnings (2012), non-native speakers consulted the ungrammatical antecedent to interpret sentence with reflexives. The eye movements of native speakers stayed within the grammatical options.

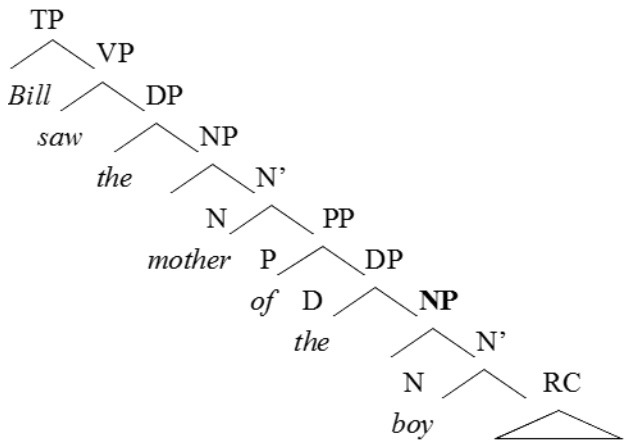
Following the predictions of the SSH, a non-native parser may rely on various non-structural cues, including social conventions, to interpret the target sentence in (1). Social conventions are biases established in society that perceive certain activities to be typically masculine, or typically feminine, etc. For example, the action of *talking about cosmetics* in (1) is most likely to be performed by a woman rather than a boy. Such a social bias would prompt HA of the RC in (1), as the agent of *talking about cosmetics* is a woman, *the mother*.

Since the SSH is a bottom-up model of sentence processing (Felser 2018, personal communication), the parser waits till the sentence is processed before it starts assigning a certain structure to the constituents. Therefore, social convention information can shape the sentence either towards HA in (4) or towards LA in (5)

(4) Bill saw **the mother** of the boy that was talking about **cosmetics**.



(5) Bill saw the mother of **the boy** that was talking about **cartoons**.



The theoretical debate about the nature of non-native processing and the scholarly need to investigate early post-initial stages of non-native processing motivated the research questions (RQ) of the study and prompted its design.

Research Questions:

RQ1: Do non-native speakers of English and Russian show L1-like patterns of RC resolution?

Hypothesis 1: RC resolution is language-specific and non-native speakers at the intermediate level of proficiency are sensitive to this cross-linguistic variation. They prefer HA in their non-native Russian and LA in their non-native English.

RQ2: Is non-native sentence processing structural and fundamentally similar to processing in the native language?

Hypothesis 2: Non-native sentence processing is structural and uses the information of a perception verb to generate a structural projection that favors HA of the RC.

RQ3: Is non-native processing governed by social biases?

Hypothesis 3: for the sake of putting forward a testable hypothesis, the study assumes that non-native processing follows social convention biases to interpret ambiguous RCs.

3. Method

The RQs and hypotheses motivated the choice of the target groups of participants and informed the experimental method and its design. Before conducting the experiment, an IRB

approval, protocol # 1602915700, was obtained. All the participants were provided with all the necessary information related to their role in the experiment. Participation in the study was voluntary and the participants could quit the experiment at any moment without any consequences.

Participants

The participants of the study were adult speakers of English and Russian. There were 10 monolingual speakers of English (NE), 9 monolingual speakers of Russian (NR), 14 participants with English as an L2 (RE), and 14 speakers of Russian as the L2 (ER). There were also two groups of L3 speakers of English with different linguistic backgrounds. Both L3 groups were native speakers of Russian. However, the participants' L2s were different. 15 people in group RFE spoke French as their L2, whereas 11 participants in group RGE had German as their L2.

The difference in the L2s in the two groups of L3 speakers does not obscure the results of the study. The hypotheses of the experiment are built around the preferred patterns of RC resolution between the L1-Russian and the L2-English. In other words, between the preference for HA typical for the native language and the preference for LA obtained in English. Both L2s of the trilingual groups belong to HA languages (see Fodor 2002 for summary), the same as their native language – Russian. Therefore, if we see a preference for HA in their L3-English, this could be due to the pattern of both previously learnt languages. At the same time, a preference for LA in English would point to a newly acquired preference for RC processing in the TL-like manner.

The current design does not address the question of whether the L1 or the L2 facilitate L3 processing, as this question is outside the scope of this study. One of the main purposes of the experiment is to compare processing in bilingual versus multilingual individuals. Therefore, we look at the intermediate level of L2 and L3 proficiency in a language that is decidedly different from the languages that have already been acquired. From this perspective, a LA-L3 can be studied against two previously acquired HA-languages, Russian and either French or German. For the same reason, L2 and L3 speakers of English and Russian form comparable groups as long as the participants match in their L*n* proficiency.

The background information of the participants, including their level of proficiency in the target language is given in Table 1.

Table 1. Participant background information

Group Characteristic	**NE** (**NS**s of **E**nglish)	**NR** (**NS**s of **R**ussian)	**E->R** (L1-**E**nglish, L2-**R**ussian)	**R->E** (L1-**R**ussian, L2-**E**nglish)	**R->F->E** (L1 **Russian**, L2 **F**rench, L3 **E**nglish)	**R->G->E** (L1 **R**ussian, L2 **G**erman, L3 **E**nglish)
C-test % correct	–	–	37% range 30-60	45% range 30-60	54% range 30-60	56% range 40-57
Length of exposure	–	–	2 years: 4 hrs/ week	4 years: 2 hrs/week	6.7 years	5.4 years
Mean age	40	29	21	30	24	25
N participants	10	9	14	14	15	11

All the non-native participants demonstrated intermediate level of proficiency in the target language, as measured by a C-test. The L3 groups were very proficient in their L2, which was confirmed by their general academic record and their results in standardized proficiency tests. The L3 participants had successfully completed several college courses in their respective L2. Besides, they regularly participated in study abroad programs and visited the countries of their respective L2s. In sum, this study tested 2 monolinguals groups of English and Russian speakers, two intermediate groups of L2 English and L2 Russian speakers, as well as two groups of intermediate speakers of English as the L3, whose L2 was very advanced.

All the participants were balanced for age. They were young adults, either college students or young professionals with degrees not lower than BA.

Materials

The study used a 2 X 2 design in both languages, English and Russian. The first condition manipulated the matrix verb between a perception and a non-perception one. A perception verb was expected to favor HA across languages and in all experimental groups. A non-perception verb would return a language-specific pattern of RC resolution. The second condition was social biases that would prompt a certain type of RC resolution.

The social conventions used in the experiment were selected from a survey taken by adult native speakers in the USA and Russia. The survey offered people a list of activities like *talking about cosmetics*, *buying flowers*, *playing in the yard* and list of possible doers of these activities, like *a man*, *a woman*, *a child*, etc. The participants were asked to match an activity with the most

likely doer of this activity. The patterns that were selected 85% and higher were chosen for the experimental study. A sample set of experimental sentences for English is given in Table 2.

Table 2. Sample stimuli quadruple in English

perception / HA bias	Bill *saw* **the mother** of the man that was talking about **cosmetics**.
non-perception / HA bias	Bill arrested **the mother** of the man that was talking about **cosmetics**.
Perception / LA bias	Bill *saw* the son of **the woman** that was talking about **cosmetics**.
non-perception / LA bias	Bill arrested the son of **the woman** that was talking about **cosmetics**.

The English stimuli have NP object head nouns of two different genders and use social gender biases to assign certain activities to be performed by either men or women. This approach could not be used in Russian. Grammatical gender is overtly marked in Russian and head nouns of different genders would entail gender marking on the complementizer, which would disambiguate the target sentence. Therefore, Russian stimuli used a different convention. They split the head nouns between different social groups by age. Table 3 shows a sample set of target sentences for Russian.

Table 3. Sample stimuli quadruple in Russian (English equivalents are shown)

perception / HA bias	Bill *saw* **the son** of the man that was **playing** in the yard.
non-perception / HA bias	Bill arrested **the son** of the man that was **playing** in the yard.
Perception / LA bias	Bill *saw* the father of **the boy** that was **playing** in the yard.
non-perception / LA bias	Bill arrested the father of **the boy** that was **playing** in the yard.

The experiment contained 40 target sentences and 40 distractors. The distractors were complex sentences that did not contain ambiguous RCs. They were also followed by a comprehension question, like in (6)

(6) My friend likes the coffee that I brought her from Brazil last year.

Who likes the coffee?

a. my friend b. me

The order of the sentences was randomized by the program Linger and each participant saw a unique sequence of experimental items.

Procedure

The experiment included three stages, pre-experimental part, the experiment and the wrap-up phase. The pre-experimental part asked the participants to fill in the linguistic background questionnaire and do the proficiency measure in the target language. Monolingual speakers of English and Russian were exempt from the language proficiency test; they only filled in the linguistic background form. The pre-testing part took the monolinguals 5-7 minutes and the non-native speakers 20-25 minutes to complete.

The main experiment started with a trial session where the participants were introduced to the format of the experiment and were prompted to use all the buttons that they would need to operate in the test trail. The experiment was a self-passed reading task, where every sentence was followed by a comprehension question. The comprehension questions had two answer choices which could be selected by pressing either the key F or the key J. To move forward, the participants had to press the SPACE bar. The main experiment took the participants 30-40 minutes to complete.

Upon completion of the experiment, the participants had an opportunity to ask questions about the study and about the implication of their result.

The results of the experiment were stored in the experimenter's password-protected computer. The study did not use real names, as all the participants were registered under coded names. For example, RE-1 meant a native speaker of **R**ussian, L2 speaker of **E**nglish, who was tested the first in the group.

Data Analysis

The data of the experiment was analyzed in R using a mixed linear model, software package lmer4. The dependent variable was Noun Choice, standing for the answer choice in the comprehension question. The noun choice showed preference for either the higher or the lower noun in RC resolution.

The choice of the noun depends on the following factors. Verb Type, or the type of the matrix predicate, checks for the effect of a perception verb to favor HA or the RC across the two languages of the experiment. Social Bias is the factor that measures whether the answer to a comprehension question depends on the activity expressed by the embedded verb and a social bias to assign this activity to a certain head noun. The third factor is Group, which allows for

comparisons between native and non-native speakers as well as for comparisons between the groups of L2 speakers vs. the groups of L3 speakers.

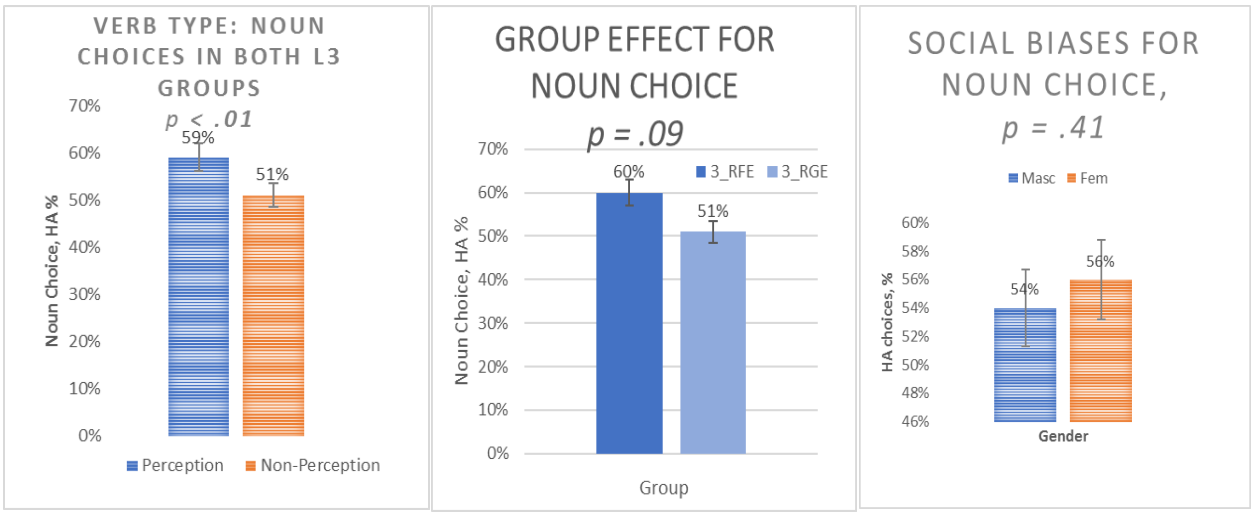
In the analysis, Noun Choice can depend on either a matrix verb, or on social biases or on group. The results are presented with **HA as a reference category**.

Results

The results are presented in three stages. First, the L3 speaker groups are compared to each other. Second, the results of all the non-native speakers of English and Russian are analyzed together and L2ers are compared to L3ers. Third, the results of non-native speakers are compared to the results in monolingual groups.

L3 speakers. The analysis of the two trilingual groups returns a significant effect of verb type, $p < .01$ *(st. error 0.025702, df 78.000000, t-value 3.367, Pr(>|t|) 0.00118)*. The effect of group is marginally significant, $p < .09$ *(st. error 0.052293, df 26.000000, t-value -1.718, Pr(>|t|) 0.09765)*. There is no significant effect of social biases, $p > .1$ *(st. error 0.025702, df 78.000000, t-value -0.823, Pr(>|t|) 0.41300)*, in RC resolution. Figure 1 shows a summary of the main effects on RC resolution.

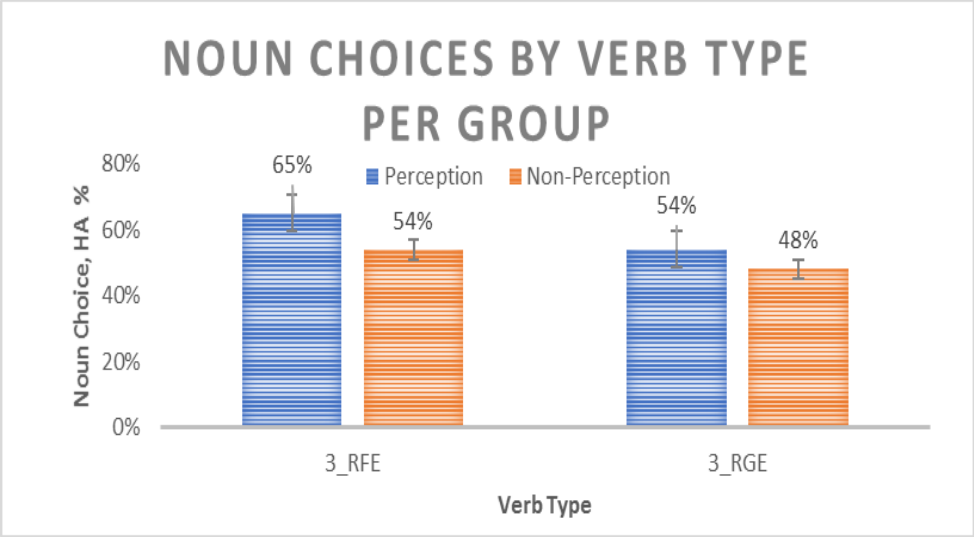
Figure 1. Main effects: RC resolution in trilingual groups



A significant effect of the verb type means that a perception verb shapes RC resolution in both groups of L3 speakers. No effect of social biases suggests that such non-structural information as social conventions does not govern L3 processing at the intermediate level of proficiency.

A marginally significant effect of group means there is no statistically significant differences between the two target groups. However, if the results of noun choice are split by group, there is a noticeable difference between them. Figure 2 shows the effect of verb type on RC resolution per group. There is no significant interaction Verb Type*Group. Figure 2 provides descriptive statistics.

Figure 2. Noun choice by verb type per group in trilinguals



The results of the verb type effect allow for an observation that the participants who speak French as their L2 are more sensitive to the effect of a perception verb than those whose L2 is German. These results speak to one of the main claims of Grillo and Costa (2014) concerning the role of a perception verb. This observation will be commented on in the discussion section.

L2 and L3 speakers. The analysis of all the non-native speakers together returns the following main effects. There is no significant effect of social biases on RC resolution, $p < .6$ *(st.error 0.017380, df 162.000000, t-value -0.533, Pr(>|t|) 0.59493).*

Noun choice is influenced by a perception verb, $p < .01$ *(0.017380 162.000000 t-value 2.877, Pr(>|t|) 0.00456)* and by group *(group_factor1, p < .001: st. error 0.042577 df 54.000000,*

t-value -22.280, Pr(>|t|) < 2e-16; group_factor2, p < .05: st. error 0.044486, df 54.000000, t-value -2.036, Pr(>|t|) 0.04666).

The group factor has three levels. A significant effect separates group RE from the three other groups and groups RE and RFE from groups RGE and ER. The RE and RFE prefer HA closer to 60% choices and groups RGE and ER closer to 50% choices. This contrast happens to be significant. Figure 3 shows a summary of main effects on RC resolution in the entire population of non-native speakers. Figure 4 shows descriptive statistics for verb type effect per group.

Figure 3. Main effects: RC resolution in all non-native groups

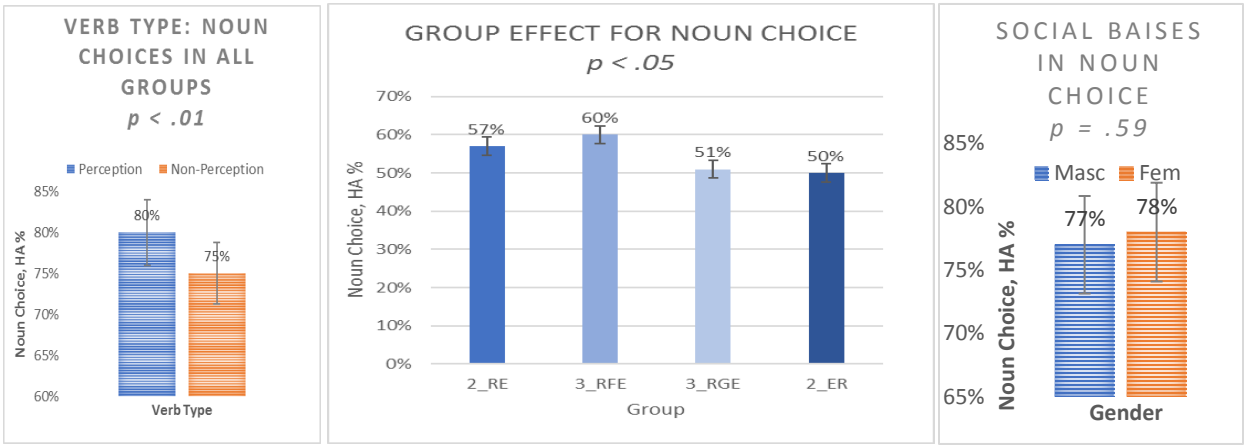
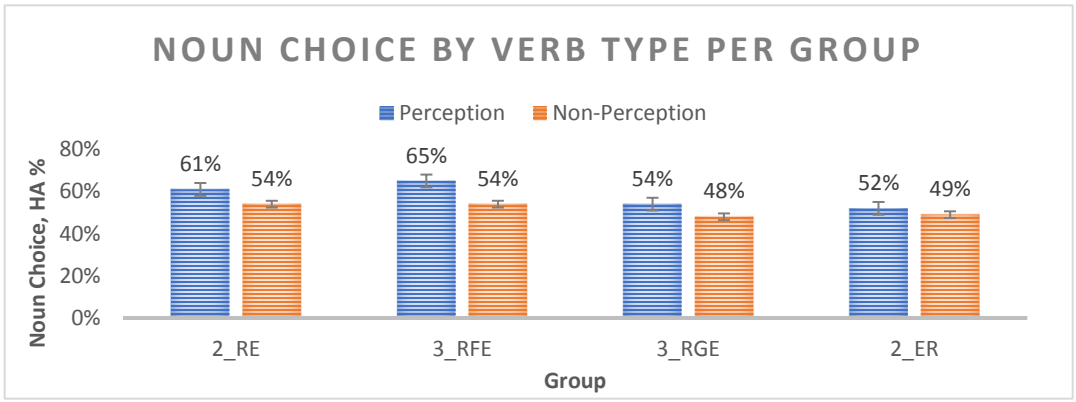


Figure 4. Noun choice by verb type per group in non-native speakers



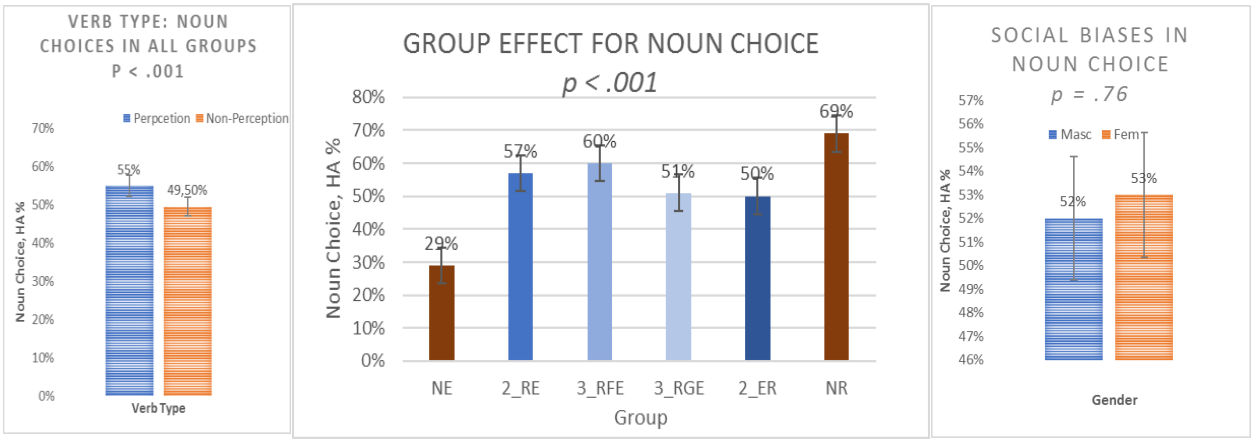
The analysis returns no significant interaction Group*Verb Type. The absence of the interaction means a perception verb has a similar effect on all the non-native speakers of English and Russian, irrespective of whether they speak the target language as an L2 or an L3. However,

Figure 4 shows a tendency for stronger effects of a perception verb in Russian than in English. This is an interesting observation concerning non-native processing. The participants show very TL-like sensitivity to the phenomenon of a perception verb. In Russian, the verb ensures the preferred HA in the RC and its effect is smaller in group RE than in any other group. All the other groups were tested in English, where a perception verb overrides the preferred pattern of LA in the RC. The effect in English as the L2 or the L3 is stronger than in non-native Russian. Group RFE is the most sensitive of the all non-native speaking group to the effect of the verb type.

Non-native speakers and monolinguals. The results of all the experimental groups together conclude the experiment analyses. This analysis allows for a comparison between monolingual processing and the processing results in non-native languages. Besides, they double-check the significance of main effects in RC resolution.

Similar to the previous analyses, there is no effect of social biases on RC resolution, $p < .76$ *(st. error 0.016344, df 219.000002, t-value -0.293, Pr(>|t|) 0.769526)*. Social biases could be a strong predictor of a certain type of RC attachment if non-native processing relied on non-structural information in RC interpretation. In comparisons between native and non-native groups, the analysis does not support the effect of social biases in RC processing. Figure 5 shows the summary of main effects on RC resolution in all groups analyzed together.

Figure 5. Main effects: RC resolution in all experimental groups

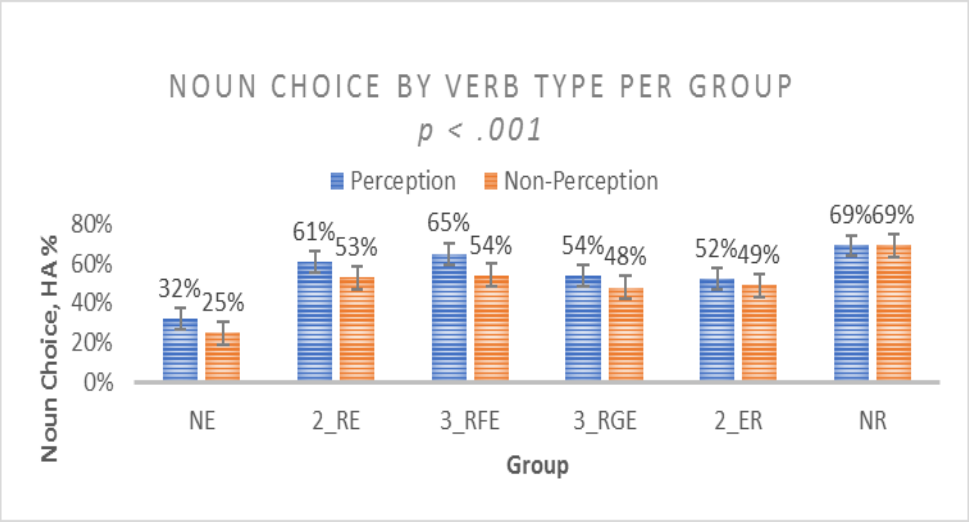


There is a strong effect of verb type, $p < .001$, which influences both native and non-native groups of participants *(st. error 0.016344 df 219.000002, t-value 3.814, Pr(>|t|) 0.000178)*. Noun choice also depends on the group, p < .001 *(group_factor1: st. error 0.016344, df*

219.000002, t-value -0.293 Pr(>|t|) 9.95e-05). In this analysis, only the first level of group factor comes out significant. This effect separates NE from all the other participants. They are significantly different in their preference for HA of the RC. NE are monolingual speakers of English, a LA-language. Therefore, their preference for HA of 29% is expected. All the other groups choose HA at 50% and above.

The analysis of verb type effect by group does not return a significant interaction. This supports the robust effect of the previous analysis: a perception verb influences all the experimental groups in the same way. However, the analysis of verb type effect by groups is used as descriptive statistics again. Figure 6 shows effect of verb type on RC resolution per group.

Figure 6. Noun choice by verb type per group in all experimental groups



The analysis of the verb type effect by group supports the observation made earlier, namely, that a perception verb has a slightly stronger effect in English than in Russian. Similar, to the observation made to Figure 4, this analysis shows a stronger effect of the verb type in all the groups tested in English, NE, RE, RFE and RGE. This is as expected, since the effect of HA in Russian, which is already a HA-language, is much smaller. A perception verb changes RC resolution preference for HA only in 3% of the choices in the ER group; there is no effect in NR group. The data in Figure 6 demonstrates that the size of the perception verb effect depends on the languages it is affecting, not on whether the language is native or non-native to the speakers.

In summary, the statistical analyses of the main effects of verb type, group and social biases on RC resolution do not support non-structural processing in either L2 or L3. There is no statistical significance of social biases on RC resolution in any of the three analysis.

The group effect shows that native speakers of English prefer HA significantly less than all the other participants. At the same time, the analysis by group does not separate the two monolingual groups, NE and NR, from the four groups of non-native speakers.

Groups effect in the analysis of the four groups of non-native speakers separates the groups by two, RE and RFE vs. RGE and ER. It does not separate L2 speakers from L3 speakers of shows that processing in L2-Russian would be different from processing in L2- or L3-English.

The results in verb type effect support structural processing in non-native languages. L2 and L3 speakers are as sensitive to the effect of a perception verb as monolinguals are. A perception verb favors HA resolution of the ambiguous RC in English and Russian as native and non-native languages. However, a perception verb is no more than one factor that shapes sentence parsing. A perception verb does not override the default preference for LA in English, and it does not exhaustively explain HA in Russian.

4. Discussion

The study reported in this paper investigates processing at the intermediate level of L2 or L3 proficiency. It attempts to provide a description of how L*n* development manifests itself in sentence processing. In addition, the study seeks experimental evidence suggesting that L2 and L3 implement the same mechanisms of sentence parsing. If this claim is corroborated, findings in L2 studies could be generalized to the entire field of non-native processing.

The first research question of the experiment explores the influence of the native or previously learnt languages on RC resolution in English and Russian as the L2 or L3. The question asks whether non-native speakers of English and Russian show L1-like patterns of RC resolution. The results of the experiment suggest a negative answer. There is no replication of L1-like English pattern of LA in the L2-Russian. Similarly, there is no preserved L1-like preference for HA in English as either L2 or L3.

The results do not support the first hypothesis claiming that RC resolution in non-native speakers at the intermediate level of proficiency would show TL-like patterns of RC resolution and preserve cross-linguistic variation. The results on RC resolution do not shows a clear

preference for HA in non-native Russian or a strong preference for LA in the non-native English. In other words, while the native attachment preferences have been abandoned, the learners are no completely target-like. The results point to a tendency to switch to the TL-like pattern of RC resolution in both L2 Russian and English and in the L3-English. This tendency may be supported in future studies with non-native speakers of English and Russian whose proficiency in the target language is higher than the proficiency in our four experimental groups.

An alternative explanation could be that the preference around 50 % and a bit higher towards HA demonstrated by non-native speakers may not reflect a developmental stage in L*n* acquisition. Optionality in RC resolution can result from a structural co-activation of both languages in the mind of the speaker. If this were the case, a study with more proficient non-native speakers would not return more TL-like results. It is possible that intermediate levels of proficiency provide enough input for the grammar to adopt both parsing preferences and co-activate them in online RC resolution. This hypothesis deserves further experimental investigation.

The analysis of group effect shows that RC resolution moves towards TL-like pattern in non-native languages. This change is evidence for mental structure building that adopts the preferences favored in the target language. The assumption of structural processing in non-native languages is further supported by the effect of verb type. This effect is the focus of the second research question.

The second research question checks whether native and non-native processing is fundamentally similar, i.e. whether both native and non-native speakers adjust their structural parse and favor of HA of the RC as prompted by the linguistic nature of a perception verb. This question receives an affirmative answer and the second hypothesis in the study is fully confirmed. A perception verb influences RC attachment resolution in all the languages of the study and in all experimental groups.

A verb type effect reported in this study goes in line with the predictions by Grillo and Costa (2014). A perception verb has the linguistic potential to trigger a projection for an eventive complement that co-exists with the restrictive RC in the mental grammar of the participants. The structural modification in the sentence with the eventive complement leaves the higher noun (*the mother* in our examples) as the only possible doer of the action expressed by the embedded verb. This indirect mental priming favors HA when the matrix clause of the restrictive RC has a perception verb.

The study provides experimental evidence for the effect of a perception verb and argues that non-native processing is based on mental structure building in the same way as native processing is. However, the results of the study do not fully support the analysis of Grillo and Costa (2014) and the conclusions of Grillo et al. (2015). Grillo and Costa claimed that language categorization into HA and LA languages was artificial because the preferred type of RC resolution totally depended on the linguistic environment created by a perception verb.

Our experimental results do not show an exhaustive role of a perception verb in RC resolution. In Russian, it creates a congruent processing condition and ensures HA, but the effect of verb type is not noticeable within the monolingual group of Russian speakers. Besides, a perception verb does not change a LA preference in English completely, even though it influences it significantly. Monolingual speakers of English are very sensitive to the effect of a perception verb but stay within their native-like preference for LA.

In this respect, our study provides an interesting result in the group of L3 speakers whose L2 is French. Even though there is no significant interaction between the effect of the verb type and the group effect, the participants in RFE show the highest sensitivity to the effect of a perception verb. This correlates with the analysis of verb type effect Grillo & Costa (2014) proposed for French, Spanish and Italian.

In Romance languages, the effect of a perception verb has a covert and an overt manifestation in RC resolution. Unlike English and Russian, where the eventive complement to a perception verb is ruled out mid-sentence, romance languages preserve it as a structural possibility till the end of the sentence. In Romance languages, a covert expression of the eventive complement is a string of words identical to the restrictive RC. Therefore, the eventive complement remains a possible satellite structure in RC processing French, Spanish or Italian till the end of the sentence.

According to Grillo and Costa, a full homonymy of the surface form between the eventive complement and the restrictive RC explains HA preference in Romance languages. Therefore, a high sensitivity of the RFE group to the effect of a perception verb can be a beneficial effect of a previously learnt Romance language on L3 processing. This possible effect requires more scholarly attention and can motivate future research.

The last question of the study investigates the assumption of shallow processing in non-native language processing. In shallow processing, social biases would be the main prompt for RC interpretation. This claim does not get experimental support in our study and the third hypothesis

arguing for non-structural processing in non-native languages is rejected. If sentence parsing were governed by such a type of non-structural information as social biases, non-native speakers would show sensitivity to them, i.e. they would build mental structural representations of the target RC following the prompts of social conventions. This would result in a significant effect of social biases in the target sentences, contrary to fact.

The absence of any effect of social conventions in RC processing raises the question of the directionality of parsing operations. A perception verb influences sentence parsing through a structural projection generated in a top-down manner. The effect of social conventional information can shape sentence processing only if mental structure building is performed bottom-up. Grillo et al. (2015) argued that a projection generated by a perception verb is easier for the parser, therefore it shapes RC resolution.

Attesting a strong effect of a perception verb in native and non-native RC resolution supports the claim of Grillo et al. (2015). The parser seems to prefer a structural projection triggered by a perception verb in our findings. This would imply that the parser prefers top-down structure building to bottom-up parsing algorithms. The priority of one of the parsing algorithms over another should become a topic of further research in native and non-native processing.

5. Conclusions

This chapter reports a study of non-native processing. In our experiment, all L2 and L3 speakers, as well as monolinguals, showed evidence of structural processing. Therefore, it can be argued that L1, L2 and L3 processing uses structural mechanisms of sentence parsing. It follows that non-native processing in L2 and L3 is fundamentally similar and most of the findings in L2 research are generalizable to the entire field of non-native processing. The intermediate level of proficiency overcomes L1-like preferences in sentence parsing and shows a tendency to parse the non-native sentences in the TL-like manner. The effect of a perception verb suggests top-down mental structure building in human language processing, which requires, and deserves, further investigation.

References

1. Clahsen, H., Felser, C. (2006) Continuity and shallow structures in language processing. Applied *Psycholinguistics*, 27 (2), 107-126.
2. Clahsen, H., Felser, C. (2018). Notes on the Shallow Structure Hypothesis. *Studies in Second Language Acquisition*, 40 (3), 693-706.
3. Cunnigs, I. (2017). Parsing and working memory in bilingual sentence processing. *Bilingualism: Language and Cognition, 20 (4)*, 659-678.
4. Dekydspotter, L., Schwartz, B. D., Sprouse R. A. (2006). The comparative fallacy in L2 processing research. In *Proceedings of the 8th Generative Approaches to Second Language Acquisition Conference (GASLA 2006)*, ed. Mary Grantham O'Brien, Christine Shea, and John Archibald, 33-40. Somerville, MA: Cascadilla Proceedings Project.
5. Dekydspotter, L., Donaldson, B., Admonds, A.C., Fultz, A.L. & Petrush, R.A. (2008). Syntactic and prosodic computation in the resolution of relative clause attachment ambiguity by English-French learners. *Studies in Second Language Acquisition*, 30, 453-480.
6. Felser, C. & Cunnings, I. (2012). Processing reflexives in English as a second language: The role of structural and discourse-level constraints. *Applied Psycholinguistics*, 33, 571-603.
7. Felser, C., Roberts, L., Gross, R., Marinis, T. (2003) The Processing of Ambiguous Sentences by First and Second Language Learners of English. *Applied Psycholinguistics* 24, 453-489.
8. Fodor, J. (1998). Parsing to learn. *Journal of Psycholinguistic Research*, 27 (3), 339-374.
9. Fodor, J. (2002). Psycholinguistics cannot escape prosody. *Speech Prosody 2002, ISCA Archive* *http://www.isca-speech.org/archive*.
10. Grillo, N., & Costa, J. (2014). A novel argument for the universality of parsing principles. *Cognition*, 133 (1), 156-187.
11. Grillo, N., Costa, J., Fernandes, B., Santi, A. (2015). Highs and Lows in English attachment. *Cognition*, 144, 116-122.
12. Ionin, T., Heejeong, K., Wexler, K. 2004. Article Semantics in L2 acquisition: The role of specificity. *Language Acquisition*, 12, 3-69.
13. Ionin, T. 2006. *This* is definitely specific: Specificity and definiteness in article system. *Natural Language Semantics*, 14: 175. doi:10.1007/s11050-005-5255-9.
14. Lardiere, D. 2009. Some thoughts on the contrastive analyses of features in second language acquisition. *Second Language Research*, 25 (2), 173-227.
15. Papadopoulou, D., Clahsen, H (2003) Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition*, 25, 501-528.
16. Phillips, C. (1996). Order and structure. MIT: Doctoral Dissertation.
17. Phillips, C., Schneider, D. (2000). Grammatical search and reanalysis. *Journal of Memory and Language* 45, 308-336.

18. Schwartz, B., Sprouse R. 1996. L2 cognitive states and Full Transfer / Full Access Model. *Second Language Acquisition*, 12 (1), pp. 40-72.
19. Slabakova, R., Montrul, S., A. 2008. Aspectual shifts: Grammatical and pragmatic knowledge in L2 acquisition. In Liceras, J. M., Zobl, H. and Goodluck, H., editors. *The role of formal features in second language acquisition*. New York: Lawrence Erlbaum Associates, 455-83.
20. Sokolova, M., Slabakova, R (2019). L3-sentence processing: Language-specific or phenomenon-sensitive. *Languages 4 (5)*, 1-17.