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L3 Sentence Processing: Language-Specific or Phenomenon-Sensitive?

Marina Sokolova [1,2,]* and Roumyana Slabakova [1,3]

[1]   Modern Languages and Linguistics, University of Southampton, Highfield Rd, Southampton SO17 1BF, UK
[2]   Bilingualism and Psycholinguistics Research Group, Northwestern University, Evanston, IL 60208, USA
[3]   Department of Language and Literature, NTNU Norwegian University of Schience and Technology, Høgskoleringen 1, 7491 Trondheim, Norway
*   Correspondence: horseshoebox@gmail.com

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Abstract: The article investigates non-native sentence processing and examines the existing scholarly approaches to L2 processing with a population of L3 learners of English, whose native language is Russian. In a self-paced reading experiment, native speakers of Russian and English, as well as (low) intermediate L3 learners of English, read ambiguous relative clauses (RC) and decided on their attachment interpretation: high attachment (HA) or low attachment (LA). In the two-by-two design, linguistic decision-making was prompted by lexical semantic cues vs. a structural change caused by a certain type of matrix verb. The results show that whenever a matrix verb caused a change of syntactic modification, which entailed HA, both native and non-native speakers abandoned the default English-like LA and chose HA. Lexical semantic cues did not have any significant effect in RC attachment resolution. The study provides experimental evidence in favor of the similarity of native and non-native processing strategies. Both native speakers and L3 learners of English apply structural processing strategies and show similar sensitivity to a linguistic prompt that shapes RC resolution. Native and non-native processing is found to be prediction-based; structure building is performed in a top-down manner.

Keywords: non-native processing; structural processing; top-down and bottom-up structure building

1. Introduction

The study reported in this article investigates non-native sentence processing in learners of English as a third language (L3). It joins the scholarly investigation of the competence and processing strategies non-native speakers apply in comprehending syntactically complex sentences. The experiment attempts to establish whether these strategies are target-language-like or native-language-like. At issue is whether L3 learners keep their native processing biases in their second or third languages, or whether they amend those biases faced with the new grammars they are parsing.

In order to address this general research question, the experiment uses the cross-linguistic variation between high (HA) and low (LA) attachment of an ambiguous relative clause (RC) to check whether at early stages of L3 acquisition speakers show either a pattern typical of the first two languages (L1 and L2) or the L3 (com 1). We explore attachment preferences in Russian and English. The examples in (1), the two answer choices in (2) and the syntactic trees in (3) and (4) (com. 2) illustrate the optionality in parsing preferences.

(1)   a. *Maria arrested the mother of the woman that was talking about cosmetics.* (English)
   b. *Maria   arestova-la   mam-u   zhenchin-y,   kotor-aya*
        Maria.Nom arrested-past.fem.sg mother-Acc.fem.sg woman-Gen.fem.sg Comp-fem.sg

> *govori-la　　　　pro　　kosmetiku.*
> speak-past.fem.sg.　about cosmetics.Acc.fem.sg
> 'Maria arrested the mother of the woman that was talking about cosmetics.'

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

　　　The two RC resolution patterns for sentence (1) are specific for certain languages: native speakers (NS) of Russian, French, Dutch, German, Greek, Spanish and Italian prefer the syntactic modification in (3) and choose answer (a) in (2), or high attachment (HA, Cuetos and Mitchell 1988; Hemforth et al. 1998; Zagar et al. 1997). At the same time, NSs of English, Norwegian, Romanian, and Swedish follow the syntactic structure provided in (4) and prefer low attachment (LA), answer (b) in (2) (Fernandez 1999; Fodor 2002).
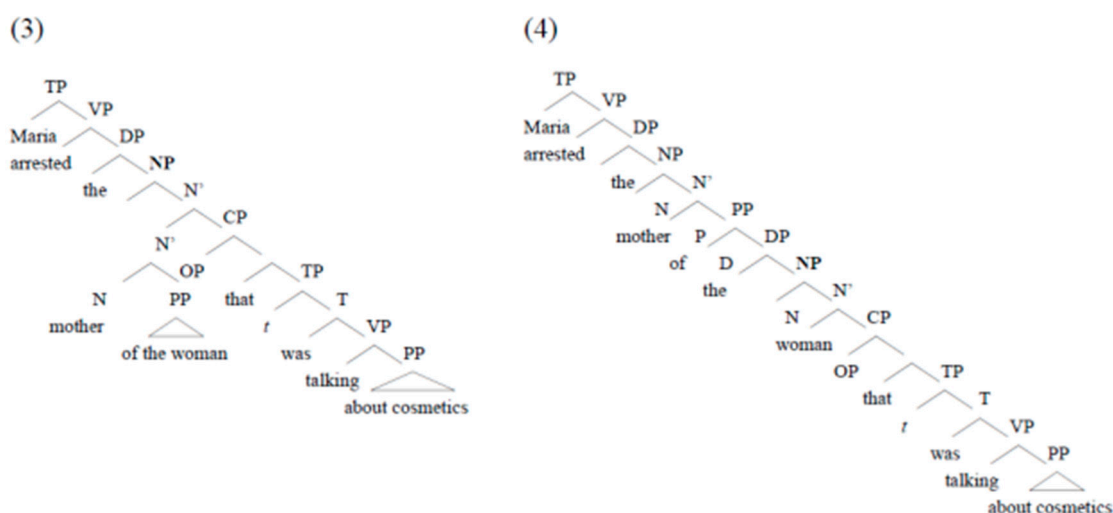
　　　L3 processing has not received much scholarly attention so far. (com. 3: Two previous studies focus their attention on RC attachment resolution: Rah (2010) and Rothman (2010)). Rah (2010) shows that proficient learners of L3 French, whose native language is German, may experience the influence of their L2 English in RC resolution. Furthermore, when English is a dominant non-native language, it changes RC resolution in L3 French. The author claims that later-learnt languages can co-influence each other's parsing. The second study, Rothman (2010), shows that HA resolution in L3 Brazilian Portuguese does not depend on the order of acquisition of the first two languages, English and Spanish. Rothman concludes that the typologically similar Spanish facilitates HA in Brazilian Portuguese. Taken together, these results open a debate on whether L3 learners copy either of the interpretation patterns of the previously learnt languages or whether they are sensitive to the syntactic cues of the language currently in use and follow its prompts for RC resolution.

　　　However, if we want to find out whether language learners can apply target-like parsing strategies from very early stages of development, a design where RC resolution patterns with one of the previously learnt languages will not show it. To investigate the ability of the parser to proceed in a targetlike manner from the very beginning, the current experiment has both the L1 and the L2 belonging to one attachment resolution group, while the newly acquired L3 belongs to the other one. Note that with only two options for attachment, we cannot fully resolve the issue of which formerly learned language may be the source of transfer.

　　　The participants of our study are low-intermediate L3 learners of English, where LA is preferred. Their two previously learnt languages favor HA: L1 is Russian for all participants; one group has German as their L2, and the other group has L2 French. The study explores language-specific RC interpretation comparing non-native L3 processing to monolingual Russian and English groups. The

combination of languages used in the experiment allows for the "same–different" comparison, thus, addressing the main theoretical debate in the field of non-native processing, i.e., whether native speakers and language learners use similar parsing strategies or not.

1.1. Two Opposing Approaches to Non-Native Processing

The two scholarly approaches that provide opposing answers to the question above are the Shallow Structure Hypothesis (SSH, Clahsen and Felser 2006, 2018) and structure-based approaches (Dekydtspotter and Renaud 2014; Dekydtspotter et al. 2008; Sprouse 2011) to sentence processing. Both approaches study sentence processing from generative perspectives. The SSH claims that non-native processing is fundamentally different from native language processing. The latter follows syntactic, or structural, parsing, whereas in the L2 the parser relies "more strongly than in native speakers on semantic, pragmatic, probabilistic, or surface-level information" (Clahsen and Felser 2018, p. 2).

The proponents of structure-based parsing argue the opposite. In non-native languages, the same as in the L1, processing is based on structure building (Dekydtspotter et al. 2008; Sokolova 2018). Structure-based approaches do not deny the role of lexical semantic information in non-native processing, but unlike for the SSH, lexical semantic information does not play a primary role in L2 processing. Just as in L1 processing, the parser is sensitive to structural information and verb-categorization at the initial analysis and uses lexical-semantic information at the level of re-analysis, rather than at the initial analysis (Ferreira and Clifton 1986, following Frazier 1990; Rayner et al. 1983; and Frazier and Fodor 1978).

Our study's experimental design allows us to test the predictions of these two theoretical approaches. Following the assumption of the SSH, non-native processing requires a strong lexical semantics or discourse predictor for sentence interpretation (Felser et al. 2003a, 2003b). In order to test this, our experiment uses social conventions for gender-biased behaviors. The embedded verb phrases in the target sentences express activities that are perceived to be typical for certain social groups; for example, men are more likely to wear ties than women. A sentence containing the RC *[that was wearing a tie]* is more likely to favor the masculine noun in a complex noun phrase (NP) *[$_{NP}$ the mother of the man]*, as well as in the NP *[$_{NP}$ the father of the woman]*. Guided by lexical semantic and discourse information, non-native speakers of English would be more likely to follow the social convention prompts in RC resolution rather than stick to the L1-like HA or the L3-like LA.

According to structure-based approaches, the parser initially generates an RC structure that is ready for semantic interpretation. The secondary semantic analysis performs a check of the grammatical adequacy of the generated structure and is not supposed to readjust the initial parse to follow social biases (Dekydtspotter et al. 2008; Hopp 2014a, 2014b, 2015, 2016a, 2016b). The ambiguity of RC resolution does not create any structural or semantic conflict and non-native speakers are predicted to keep a language-specific RC resolution pattern: LA in English, their L3, and HA in Russian.

Further evidence for structure building in L2 parsing can be obtained through measuring the effect of the matrix predicate that favors HA in monolingual speakers of French, Spanish, Italian (Grillo and Costa 2014) and English (Grillo et al. 2015). As proposed by Grillo and Costa (2014), a perception verb triggers a projection for an eventive complement. If a perception verb (e.g., *see*) is placed in the matrix clause of the RC, the generated projection expects any activity expressed by the embedded verb to be performed by the first noun in the complex NP *[. . . <u>saw</u> [$_{SC}$ somebody doing something]]*. A switch to HA is explained by the switch of the syntactic modification from the complex NP to the matrix verb in the eventive interpretation. The eventive complement of the verb *see* is a Small Clause (SC) that includes the head nouns and the reduced RC.

As argued for by Grillo and Costa (2014), a perception verb creates a linguistic environment where HA is strongly favored even in LA languages. This claim received experimental evidence from Grillo et al. (2015): adult English-speaking monolinguals preferred HA after a perception verb in the matrix clause. Thus in our experimental study, a perception verb is expected to favor HA in both

Russian and English and both native and non-native speakers are expected to be sensitive to the effect of the perception verb in the matrix clause.

Finally, the conflicting predictions of the SSH and structure-based approaches raise the question of the directionality of parsing operations in both native and non-native languages. Parsing directionality refers to two strategies for structure building: top-down and bottom-up. The SSH suggests that building a syntactic tree happens from the bottom up (Felser 2018, personal communication). The non-native parser processes the incoming lexical semantics to understand a sentence at the level of initial analysis. Then it generates a bottom-up syntactic structure to accommodate the initial interpretation.

On the other hand, if parsing is performed top-down and is prediction-based, a perception verb can influence RC resolution. To favor HA in an English RC, the parser must have decided that an eventive complement is the most likely constituent in the in-coming string. This happens after encountering the matrix verb, but before coming across the complementizer *that*. The complementizer "tells" the parser that a restrictive RC reading is also an option, the latter entailing LA preference in English. Our findings highlight the effect of a perception verb as a linguistic cue for sentence interpretation and advocate for phenomenon-sensitive and prediction-based type of sentence processing in both native speakers and adult non-balanced trilinguals.

In the next section, we present a review of the relevant literature that explains the main predictions, research questions and hypothesis of the study. It is followed by a detailed description of the experiment, its design, procedure and participants. The results of the study are given in a separate sub-section of the Experiment. The following section discussesthe outcomes of the study and suggests their further implications.

1.2. Previous Studies

It has been argued that parsing preferences do not transfer. For example, no L1-like processing patterns were attested in studies with advanced L2 learners in Papadopoulou and Clahsen (2003); Felser et al. (2003a, 2003b), nor in experiments with low-intermediate L2 learners in Dekydtspotter et al. (2008). The proponents of different approaches to non-native processing agree that multilinguals develop certain processing strategies to deal with non-native sentences (Papadopoulou and Clahsen 2003; Cuetos and Mitchell 1988; Dussias 2003; Dussias and Sagarra 2007; Dekydtspotter et al. 2008). The bilingual parser adjusts to the L2 (Frenck-Mestre and Pynte 1997, Frenck-Mestre 2005). In other words, it attunes its parsing strategies to the patterns of the target language (Cuetos and Mitchell 1988). Late bilinguals and heritage speakers adopt the parsing preferences of the language they are being exposed to (Dussias 2003; Dussias and Sagarra 2007). Sensitivity to target language structures may show at relatively early stages of adult L2 acquisition. For example, it has been shown that low-intermediate learners are sensitive to the default prosodic organization of their L2 French (Dekydtspotter et al. 2008). French prosody facilitates a switch to the target-language-like HA in French. At the same time, respondents preserve LA preference in their native language, English (Dekydtspotter et al. 2008). Adult L2 speakers start switching to the L2-like RC resolution pattern in their L2 Russian or English at a low-intermediate level of proficiency (Sokolova, in press). L2 speakers of Russian and English switch to HA in RC resolution when the matrix clause has a perception verb, the effect predicted by Grillo and Costa (2014). In their sensitivity to the perception verb, L2 learners of Russian parse sentences Russian-like and L2 learners of English do so like English monolinguals (com. 4) (Sokolova, in press) The same tendency is observed in heritage language as well. Targetlike performance in Spanish was attested by Jegerski et al. (2016). The latter study reports that (com 5) heritage speakers of Spanish, who are early learners of English, preserve Spanish-like parsing in choosing HA in Spanish and are not affected by their day-to-day exposure to English (Jegerski et al. 2016).

On the other hand, there are also studies where advanced L2 learners show no preference in RC resolution in the L2 without a strong lexical semantic prompt (Papadopoulou and Clahsen 2003; Felser et al. 2003a, 2003b). A preposition between the head nouns can provide an interpretation cue, for example, *with* instead of *of*, as in (5):

(5)   Maria arrested the mother <u>with</u> the woman that was talking about cosmetics.

The preposition *with* should ensure LA resolution preference in L2 English for NSs of HA languages (Felser et al. 2003b). When the experimental conditions force a HA reading in the *with*-condition, advanced non-balanced bilinguals read the target sentences slower (Felser et al. 2003a). The fact that monolingual children show no sensitivity to the effect of the preposition *with* in Felser et al. (2003b) allows for the conclusion that NSs and adult L2 learners apply different processing strategies. Such findings prompt the SSH proponents to argue that L2 speakers make primary use of non-structural information (Clahsen and Felser 2018).

Nevertheless, the conclusion about processing differences in monolinguals and bilinguals is rendered problematic when considering the results of a study with NSs of Spanish (Cuetos and Mitchell 1988). Monolingual Spanish respondents switch to LA in sentences with *y* 'and' between the head nouns. This change somehow patterns with the results attested by Felser et al. (2003a) and Felser et al. (2003b). Frazier and Clifton (1997) claim that the preposition *with* assigns a theta role to the following constituent. Besides, the preposition *with* changes the syntactic modification in the complex head NP *[NP the mother with the woman]* from a determiner phrase to a coordination phrase (CoordP) *[CP Maria arrested [CoordP [NP the mother] with [NP the woman] [CP that was talking about cosmetics].* It is debatable whether a change of NP modification that causes LA resolution occurs due to the semantics of the preposition *with* or this preposition can function as a conjunctor. Meanwhile, the L2 learner results in Felser et al. (2003a) and Felser et al. (2003b) pattern with the results of monolingual speakers of English in Traaxler et al. (1998) and in English and Spanish by Gilboy et al. (1995), where LA is a strong preference when the head nouns are joined by the preposition *with.* Such similarity of RC resolution in analogous linguistic environments suggests that some parallels do exist between native and non-native processing.

Since the overall findings on RC resolution in the second language are somewhat mixed, it is justified to extend research on the topic with new conditions and groups of learners. In the current study, non-native processing strategies are tested with low intermediate L3 learners of English. There is a strong syntactic predictor that we explain directly below; namely, a perception verb in the matrix clause that favors HA in all languages and all conditions.

1.3. Pseudo Relatives and Predictive Processing

Grillo and Costa (2014) first noticed the role of a perception verb as the matrix predicate and used it as an explanation of how a universal preference for LA is overridden in Romance languages. A further study by Grillo et al. (2015) showed the universal potential of a perception matrix verb to change RC resolution preference towards HA across languages.

A perception verb changes the RC interpretation due to its syntactic ability to have an eventive complement as in (6).

(6)   Maria saw [SC the mother of the woman talking about cosmetics]
<u>Interpretation</u>: Maria witnessed an act of talking about cosmetics performed by the mother of the woman.

The small clause in (6) modifies the matrix verb and creates an event-oriented interpretation. Grillo and Costa (2014) call it a Pseudo-Relative (PR) reading. In Romance languages such as French, Spanish and Italian, both syntactic modifications as in (7a) and (7b) are possible. Although the surface word orders of (7a) and (7b) are identical, the syntactic modification in (7b) is different: a PR, not a real RC (Grillo and Costa 2014). The examples are from Spanish.

*(7)   a.   María **vio** a . . . .. [DP la madre de la mujer] [CP que estaba hablando de cosméticos]].* (RC)
                Maria ***saw***   the mother of the woman   that was talking about cosmetics
        *b.   María **vio** a [SC [DP la madre de la mujer] [CP que estaba hablando de cosméticos]].* (PR)
                Maria ***saw***   the mother of the woman that   was talking about cosmetics

The current study follows Grillo and Costa's (2014) analysis and compares the PR and the restrictive RC readings in an experiment with English and Russian. When a perception verb is placed in the matrix clause of an RC, neither Russian nor English allow a PR reading as a default interpretation that could be added to the two possible readings of a restrictive RC. Both languages require a covert change of structure, such as in (8b) for English. In Russian, the event-oriented interpretation requires a finite adverbial subordinate clause.

(8)　a.　　*Maria **saw** (who?)[DP the mother of the woman] [CP that was talking about cosmetics]* [1]. *(RC)*

　　　b.　　*Maria **saw** (what?) [SC [DP the mother of the woman] [VP talking about cosmetics]. (PR)*

As shown in (6) and (8b), the only possible doer of the action of talking in an event-oriented, or a PR reading, is *the mother*; the second noun, *the woman*, is excluded from the interpretation options. Thus, when a perception verb is placed in the matrix sentence of an RC, HA is preferred even in LA languages like English (Grillo et al. 2015).

On coming across a perception verb in the matrix clause, the parser anticipates a complement: *who* or *what*. The complex head NP satisfies the *who* expectation, but the *what*-complement, or an event-oriented syntactic projection as in (8b) still remains possible (Grillo and Costa 2014; Grillo et al. 2015). In other words, at this point the parser may make a top-down prediction to project an eventive complement. This projection modifies the matrix verb and identifies the first noun of the head NP *[NP the mother of the woman]* as the doer of the up-coming activity. Due to its syntactic ambiguity, a restrictive RC does not force any reanalysis of previous parsing decisions, since both HA and LA are grammatical. Thus, the parser sticks to the initially generated event-oriented projection and parses the RC as modifying the higher noun, which results in HA resolution of the RC.

For native and non-native speakers alike, the effect of the perception verb should be the same if both groups apply structural processing for language comprehension. On the contrary, if non-native processing is governed by non-structural information, non-native speakers should follow social conventional biases to interpret restrictive RCs as explained above. Since the SSH is a bottom up processing model (Felser, personal communication), the possible effect of the perception verb is predicted to be annulled by the time the parser processes the entire sentence. If the attachment resolution is based on lexical semantic information, the interpretation decision should be made at the level of key words, like *cosmetic*s in (9a) and *soccer* in (9b). There should be a slow-down in reading times (RT) at these words (Felser, personal communication).

(9)　a.　　*Maria saw [DP the mother of the man] [CP that was talking about cosmetics]. (favors HA)*

　　　b.　　*Maria saw [DP the mother of the man] [CP that was talking about soccer]. (favors LA)*

In addition, the languages of the experiment, Russian and English, make an interesting combination. Both are non-PR languages, as neither allows a RC-like string to be interpreted eventively with a default PR reading. However, Russian and English belong to different attachment resolution groups, Russian being HA, English—LA. Recall that the PR interpretation in English is not possible for the RC string but has to have a different word order, see example (8b). The second languages of the participants are German (group 1) and French (group 2). Both of these languages belong to the HA group for RC resolution (Cuetos and Mitchell 1988; Hemforth et al. 1998; Zagar et al. 1997). Thus, all the previously learnt languages of the participants are HA languages, and the third language being acquired is a LA language, English. However, there is a further interesting distinction between the two L2s. As shown by Grillo and Costa (2014), French allows both the default PR-reading and the RC reading, in (10a) and (10b). Note that there is no distinction in word order between the embedded clause strings, although the interpretations are different.

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[1]　　In addition, the CP in 8a cannot modify the matrix subject.

(10) a.　　*Marie a écouté [*$_{NP}$ *la mère de la femme]*　　*[*$_{CP}$ *qui parlait de cosmétiques]. (RC, French)*

　　　　　Maria hear.PAST the mother of the woman that talk.PAST about cosmetics
　　　　　Maria heard the mother of the woman that was talking about cosmetics.

　b.　　*Marie a écouté [*$_{SC}$ *[*$_{NP}$ *la mère de la femme]　[*$_{CP}$ *qui parlait　de cosmétiques]]. (PR, French)*

　　　　　Maria hear.PAST the mother of the woman that talk.PAST about cosmetics
　　　　　Maria heard that the mother of the woman was talking about cosmetics.

Unlike French, German requires an overt change of the embedded clause string for an event-oriented interpretation, thus patterning with both Russian and English. The German sentence has the infinitive in the SC, as shown in (11).

(11) Maria hörte [$_{SC}$ *[*$_{NP}$ *die　　Mutter der　　Frau], [*$_{CP}$ *die über Kosmetika sprechen]]. (PR, German)*

　　Maria hear.PAST the.ACC mother the.GEN woman that about cosmetics talk.INF.
　　'Maria heard that the mother of the woman was talking about cosmetics.'

Table 1 summarizes the attachment preferences and possible eventive readings of the embedded clause in the languages under discussion.

Table 1. Relative clause (RC) attachment preference and embedded-clause eventive reading for the languages considered in the experiment.

	L1 Russian	L2 German	L2 French	L3 English
Attachment preference	HA	HA	HA	LA
Eventive reading of a RC-like string	No	No	Yes	No

Based on the linguistic facts and the two processing approaches introduced above, our study puts forward the following research questions (RQ) and hypotheses:

RQ 1: Are native speakers and low intermediate L3 learners equally sensitive to structural cues for sentence interpretation?

Hypothesis 1: *In the given experimental setting, structural processing is governed by a perception verb in the matrix clause. Both native and non-native speakers will be sensitive to the effect of the perception verb and prefer HA resolution under its influence.*

RQ 2: Does non-native processing rely on non-structural information for RC resolution?

Hypothesis 2: *In bottom-up processing, a predictive projection of a perception verb has no effect. The RC interpretation decision will follow social conventions and will be made at the level of disambiguating words.*

2. Experimental Materials and Methods

2.1. Design

In both Russian and English, the study maintains a two-by-two design. The matrix verb (perception and non-perception) is crossed with social gender-biased interpretations of the RC towards one of the head nouns. Russian and English differ in the way they mark grammatical gender. Russian gender is overtly marked on the head nouns. As a result, the complementizer, the embedded verb, and the animate head nouns must be of the same gender to keep the sentence ambiguous. This grammatical constraint makes it impossible to manipulate the exact same gender conventions in the Russian stimuli. Russian and English stimuli, therefore, use different conventions. However, both stimuli sets were

created based on surveys taken among adult native speakers of the respective languages in Russia and the USA. Each survey presented the participants with two lists organized in two columns. List 1 contained 40 activities *(ex., talk about cosmetics, buy flowers)*, list 2 contained possible doers of certain activities *(ex., a woman, a boy, an old man)*. In English, the nouns in list 2 were of the opposite gender. In Russian, they belonged to different social groups differentiated by age *(ex., children and adults)*. The survey asked adults in both countries to choose the most likely doer of an activity. Table 2 provides an example of a survey item.

Table 2. Sample survey item: Pick the most likely doer of the activity in column 2 from the list in column 3. There can be more than 1 answer.

Your Answer	Activity	Doer
	Talk about cosmetics	Man
	Buy flowers	Woman
	Play with a kitten	Child
	Talk about soccer	Boy
	Wear a tie	Old man
	Drink coffee	Girl
	Wear a skirt	Old woman
	Play in the yard	Baby
	Talk on the phone	

If more than 85% of the respondents matched a certain activity with a certain doer, the pair was used for the stimuli design. The patterns that did not register consistent preference among native speakers were discarded. Table 3 shows a sample stimulus set for English. Table 4 shows the stimuli for Russian (a full list of target sentences can be found in the Appendix A).

Table 3. Sample stimuli in English.

	Head Noun 1	Head Noun 2
Perception	Maria <u>saw</u> the *mother* of the man that was talking about *cosmetics* in the yard	Maria <u>saw</u> the mother of the *man* that was talking about *soccer* in the yard
Non-Perception	Maria <u>arrested</u> the *mother* of the man that was talking about *cosmetics* in the yard	Maria <u>arrested</u> the mother of the *man* that was talking about *soccer* in the yard

Table 4. Sample stimuli in Russian.

	Head Noun 1	Head Noun 2
Perception	Мариявидела п*апу* мальчика, который покупалцв*е*ты во вдоре. Maria <u>saw</u> the *father* of the boy that was buying *flowers* in the yard.	Мариявидела папу *мальчика*, который игралс кот*е*нком во дворе. Maria <u>saw</u> the father of the *boy* that was playing with a *kitten* in the yard.
Non-Perception	Марияарестовала п*апу* мальчика, который покупалцв*е*ты во вдоре. Maria <u>arrested</u> the *father* of the boy that was buying *flowers* in the yard.	Марияарестовала папу *мальчика*, который игралс кот*е*нком во дворе. Maria <u>arrested</u> the father of the *boy* that was playing with a *kitten* in the yard.

The experimental items included 40 target sentences and 40 distractors. The distractors were complex sentences with non-ambiguous subordinate clauses. All the sentences were followed by a comprehension question with two answer choices as in (12).

(12)　*A woman with a child is walking in the park that was opened in the city. (distractor)*

　　What was open?

(a) the park; (b) the city

The order of the sentences was randomized by the experimental platform and never repeated from one participant to another.

2.2. Procedure

The experiment used a self-paced reading task administered through a software platform for linguistic experiments, Linger. Participants were instructed on what they were expected to do and how to navigate the interface. A practice session contained six simple sentences that varied in length from 5 to 12 words. The instructions on what to do appeared on the screen; participants were invited to try out all the buttons they would be using in the experiment. The practice session gave participants an opportunity to get used to a moving window screen and made sure they understood what button corresponded to each of the two answer choices. After the practice session was over, a notification appeared on the screen. The main experimental task followed.

Prior to the experiment, the participants filled in a linguistic background questionnaire and an independent proficiency task, a C-test designed in accordance with the guidelines of Iowa State University, 1998. The cut-off criteria for participation was set at 30% correct. A low bar of 30% was established: it was the lowest score that could not be obtained by simply guessing a word.

The entire testing time was, on average, 40 min in the non-native language and 30 min in the native language. Each group of participants was tested only once. Native speakers of Russian and English were tested in their respective languages. L3 speakers of English were tested) (com. 7) only in English. All the testing took place by individual appointment at an hour preferred by the participant.

2.3. Participants

The study participants formed four groups: Two groups of monolingual speakers of English (Native English, NE) and Russian (Native Russian, NR) and two experimental groups of L3 learners of English: Group 1 is L1 Russian/L2 German/L3 English (RGE) and Group 2 is L1 Russian/L2 French/L3 English (RFE). Both trilingual groups were balanced in age and in the amount of L3 exposure and proficiency. There was no significant difference between the two experimental groups in proficiency, *p* = 0.739. Table 5 shows the background data of the participants of the study per group.

Table 5. Background information of the participants in each group.

Group	NE Native Speakers of English	NRN ative Speakers of Russian	RGE L3 Speakers of English, Native Speakers of Russian, Second Language—German	RFE L3 Speakers of English, Native Speakers of Russian, Second Language—French
Number	10	10	15	15
Length of exposure to L3	n/a	n/a	3 years in college	3 years in college
Mean age	40	33	22	25
C-test, % correct (range)	n/a	n/a	56 (43–60)	56 (30–64)

All the L3 participants were (com. 8) students of linguistics in a Russian University They were highly proficient in their respective L2s and had been exposed to them since the age of 6 or 7. All the participants took the university language proficiency exams in reading, writing, speaking and listening every 4 months. Their results in the most recent testing in their respective L2s (German or French) correspond to the advanced (C1) level of proficiency in the Common European Framework of Language Proficiency Assessment. In addition to classroom exposure in the L2, most participants reported multiple visits to the countries of their respective L2s for both work and study.

3. Results

The data obtained in the experiment were analyzed (com. 9) with linear mixed models using the R software for statistical analysis. The experiment was looking for a group effect to distinguish between native and non-native processing patterns; for a verb-type effect to check whether the predictive top-down processing was easier and preferred by the human parser; for an effect of social conventions in the interpretation decision to check whether the L3 groups primarily relied on non-structural information in RC resolution; and for a group effect to see possible differences between native and non-native speakers.

There was a strong group effect. Native speakers of Russian and English and English as an L3 learners made different decisions on RC resolution. Overall, with both predicates, NR prefer HA 69% of the time, NE 29% of the time, RGE 51% of the time, RFE 60% of the time. L3 speakers of English differ from NE, $p < 0.001$, as well as from NR, $p < 0.05$ Meanwhile, there was no difference between the two experimental groups, see Table 6 below.

In the statistical analysis (Table 6), Group_factor1 compares *NE* to the three other groups, *RFE + RGE + NR*. Group_factor2 compares the two groups of *NE + RFE* against the two groups of *RGE + NR*. Group_factor3 compares the three groups of *NE + RFE + RGE* against the group of *NR*. VerbType_factor1 compares the sentences with a perception verb against the sentences with the non-perception matix verb.

The group difference is significant only when L3 speakers are compared to monolinguals (Group_factor1 and Group_factor3), see Table 6.

Table 6. R statistics. Fixed effects: group and verb type.

	Estimate	Std. Error	df	t Value	Pr(>|t|)
(Intercept)	0.524444	0.025967	45.000000	20.197	<0.0001 ***
Group_factor1 NE vs. RFE+RGE+NR	0.309760	0.062634	45.000000	4.946	<0.0001 ***
Group_factor2 NE+RFE vs. RGE+NR	0.001187	0.059626	45.000000	0.020	0.984207
Group_factor3 NE+RFE+RGE vs. NR	0.182071	0.078293	45.000000	2.326	0.024611 *
VerbType_factor1 Perc. vs. Non-Perc	0.068889	0.016756	45.000000	4.111	0.000165 ***

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Table 6 also shows that the verb type (VerbType_factor1) had a significant overall effect on RC resolution, $p < 0.001$. All the participants taken together prefer HA with a perception verb 56% of the time, as opposed to LA, 44%.

The statistical analysis shows no Group*VerbType interaction, which means that a perception verb influenced all the groups of participants in the same way. In addition, the descriptive statistics summarized in Table 7 are also worth examining. Table 7 shows percentage of HA choices per group in sentences with a perception and a non-perception verb.

Preference for HA with the perception verb predicate vs. the non-perception one is 1% higher in native Russian, 7% higher in native English, 6% higher in trilingual RGE group and 11% higher in the trilingual RFE group (Table 7). Therefore, the effect of a perception verb is more salient in English (NE, RFE, RGE) than in Russian (NR). Russian is a HA to start with and a perception verb just creates a congruent processing condition for RC resolution. In English, the effect of the perception verb goes against the preferred LA choice. Both native and non-native speakers of English are sensitive to this VerbType effect.

Table 7. Descriptive statistics: No Group_VerbType interaction.

	NE	RFE	RGE	NR
Perception verb	32%	65%	54%	69%
Non-Perception verb	25%	54%	48%	68%

There was no group*verb type interaction, *p* = 0.1. This suggests that a perception verb in the matrix clause influences all the participants in the same way.

Finally, there was no effect of social biases for RC resolution or any increase in the RT at the disambiguating word on RC resolution, *p* = 1, see Table 8.

Table 8. Fixed effects: social biases and reading times (RT) at the critical area.

	Estimate	**Std. Error**	**df**	*t* **Value**	**Pr(>|t|)**
(Intercept)	5.225e-01	3.729e-02	7.688e+01	14.012	<0.001 ***
Social_factor1	−2.712e-02	1.712e-02	1.770e+02	−1.584	0.1149
RTverb	5.392e-05	3.712e-05	1.012e+03	1.452	0.147

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

4. Discussion

The general question of the study concerns the type of processing strategies used in non-native sentence processing. The two main psycholinguistic approaches predict that non-native speakers would either rely more on social conventions to interpret ambiguous RCs or apply structural parsing and process them as monolinguals.

In our experimental findings, the effect of social conventions on interpretation did not reach significance in either monolingual or trilingual groups. This demonstrates that non-structural information did not shape linguistic decisions in non-native processing. In the given experimental setting, the participants' linguistic decision making was not governed by social biases (e.g., men wearing ties, women talking about cosmetics, etc.). There was no difference between the way native and non-native speakers dealt with social conventional information, which clearly indicates similarity in processing mechanisms between native and non-native speakers.

A strong group effect points to two crucially important findings: RC resolution is language specific and low-intermediate non-native speakers of English may be on their way to switching to the target-language-like LA in English. The difference in HA preference between native speakers of Russian and English supported the previously identified language-specific preferences for LA in English and HA in Russian. Non-native speakers were significantly different from both monolingual groups and on their way to target-like performance. Being different from native speakers of Russian meant that they had already abandoned their L1-like interpretation pattern, even at their (low) intermediate level of proficiency. Meanwhile, they had not reached native-like percentages in RC resolution preference in their L3 English yet. It should be noticed that the participants' previous linguistic experience did not contain LA languages. In addition, they were expected to switch to LA in English despite the effect of the perception verb, which strongly favors HA. Bearing in mind that the participants' proficiency level in the L3 was relatively low, these results suggest a developmental stage of L3 acquisition. At higher proficiency levels, L3 speakers may very well show an L3-like LA preference.

A developmental progress towards LA in L3 English, as we established it here, is in contradiction to the results on RC resolution in Papadopoulou and Clahsen (2003) and Felser et al. (2003a, 2003b). Without a semantic cue, their advanced non-native speakers showed RC resolution preference around 50%, which the authors legitimately report as lack of preference in a non-native language. The disparity of results requires a replication of the current experiment with a highly proficient non-native group, for the two studies' results to be compared usefully.

The most significant finding of our study is the effect of the perception verb, which affects native and non-native speakers in the same way. Favoring HA in the perception verb condition means that, on coming across a perception verb, both native and non-native speakers in high and low attachment languages expect an eventive complement. This finding supports the universality of Grillo and Costa's (2014) analysis. The predicted projection imposes a parsing decision which is not re-considered at the level of RC resolution, further down in the syntactic tree. In both Russian and English, in both native or non-native processing, structural parsing appears to be top-down and prediction-based. Parsing

decisions of higher processing cycles are not re-analyzed unless the grammar forces such re-analysis. In the current experiment, the ambiguity of the RC gets the parsing adjusted to the initial HA decision, even when the genuine language-specific preference for attachment resolution is LA, as in English. This finding emphasizes the similarity in processing strategies between native and non-native speakers. Both native and non-native participants were sensitive to the predictive power of the perception verb. All the participants followed the same processing mechanism and stuck to the initial parsing decisions when processing complex syntactic strings.

A shift towards HA in the perception verb condition in every group invites an interesting observation. Even though there was no interaction between the group effect and the verb type effect (i.e., all the groups of participants responded sensitively to the matrix verb), their sensitivity to the pseudo-relative option was different. In Russian, a perception verb additionally supports HA but the participants chose HA with the perception verb only 1% more often than with a non-perception matrix predicate. For native speakers of English, the choice for HA in the perception matrix verb condition increased by 7%. This effect appears to override the default preference for LA in English.

The sensitivity to the effect of the perception verb in L3 groups is also slightly different: the group with the L2 German increased its HA choice by 6%, whereas the group with the L2 French chose HA 11% more often with the perception verb than with the non-perception one. Thus, the L2 French group appears to be more sensitive to the effect of the perception verb than the other trilingual group. That is likely because French is the only language in the participants' background that allows pseudo-relatives as a default interpretation of the RC-like string. Having acquired a specific linguistic property in the L2, the learners show higher sensitivity to it in the L3. This finding points towards possible facilitative effects in L3 acquisition coming from the different properties of previously acquired languages.

In conclusion, this experiment demonstrates that RC resolution preference is a language-specific phenomenon and L3 speakers start adjusting to the target-language-like parsing in their non-native language as early as (low) intermediate levels of proficiency. Both native and non-native speakers are equally sensitive to the effect of a linguistic cue placed outside of the RC and shape their resolution preferences accordingly, thus showing phenomenon-sensitive processing.

Appendix A

Target sentences English
1
Maria saw the mother of the man that was talking about soccer
Maria saw the son of the woman that was talking about soccer
The police attested the mother of the man that was talking about soccer
The police arrested the son of the woman that was talking about soccer
2
Maria saw the mother of the man that was talking about cosmetics.
Maria saw the son of the woman that was talking about cosmetics.
The police arrested the mother of the man that was talking about cosmetics.
The police arrested the son of the woman that was talking about cosmetics.
3
A neighbor saw the husband of the woman that was buying flowers on the corner.

A neighbor saw the wife of the man that was buying flowers on the corner.

Maria arrested the husband of the woman that was buying flowers on the corner.

Maria arrested the wife of the man that was buying flowers on the corner.

4

A neighbor saw the husband of the woman that was buying coffee on the corner.

A neighbor saw the wife of the man that was buying coffee on the corner.

Maria arrested the husband of the woman that was buying coffee on the corner

Maria arrested the wife of the man that was buying coffee on the corner.

5

Bill saw the daughter of the man that was talking about politics in the cafe

Bill saw the father of the girl that was talking about politics in the café

The doctor called the daughter of the man that was talking about politics in the cafe

The doctor the father of the girl that was talking about politics in the café

6

Bill saw the daughter of the man that was talking about fashion in the cafe

Bill saw the father of the girl that was talking about fashion in the café

The doctor called the daughter of the man that was talking about fashion in the cafe

The doctor called the father of the girl that was talking about fashion in the cafe

7

The doctor saw the sister of the man that was choosing a tie in the shop

The doctor saw the brother of the woman that was choosing a tie in the shop

Bill stopped the sister of the man that was choosing a tie in the shop

Bill stopped the brother of the woman that was choosing a tie in the shop

8

The doctor saw the sister of the man that was choosing a shawl in the shop

The doctor saw the brother of the woman that was choosing a shawl in the shop

Bill stopped the sister of the man that was choosing a shawl in the shop

Bill stopped the brother of the woman that was choosing a shawl in the shop

9

A teacher saw the nephew of the woman that was looking at the flowers in the park

A teacher saw the aunt of the man that was looking at the flowers in the park

The boss interrupted the nephew of the woman that was looking at the flowers in the park

The boss interrupted the aunt of the man that was looking at the flowers in the park

10

A teacher saw the nephew of the woman that was looking at the boats in the park

A teacher saw the aunt of the man that was looking at the boats in the park

The boss interrupted the nephew of the woman that was looking at the boats in the park

The boss interrupted the aunt of the man that was looking at the boats in the park

Target sentences Russian

1

Мария видела папу мальчика, который покупал цветы во дворе

Мария видела сына мужчины, который покупал цветы во дворе

Соседка позвала папу мальчика, который покупал цветы во дворе

Соседка позвала сына мужчины, который покупал цветы во дворе

Maria saw/A neighbor called the father of the boy/the son of the man that was buying flowers in the yard.

2

Мария видела папу мальчика, который покупал мороженое во дворе

Мария видела сына мужчины, который покупал мороженое во дворе

Соседка позвала папу мальчика, который покупал мороженое во дворе

Соседка позвала сына мужчины, который покупал мороженое во дворе

Maria saw/A neighbor called the father of the boy/the son of the man that was buying ice-cream in the yard.

3

Соседка видела внука мужчины, который поставил машину во дворе

Соседка видела дедушку мальчика, который поставил машину во дворе

Мария позвала внука мужчины, который поставил машину во дворе

Мария позвала дедушку мальчика, который поставил машину во дворе

A neighbor saw/Maria called the grandson of the man/the granddad of the man that parked the car in the yard.

4

Соседка видела внука мужчины, который игралс котенком во дворе

Соседка видела дедушку мальчика, который игралс котенком во дворе

Мария позвала внука мужчины, который игралс котенком во дворе

Мария позвала дедушку мальчика, который игралс котенком во дворе

A neighbor saw/Maria called the grandson of the man/the granddad of the man that played with a kitten in the yard

5

Врач видел маму девочки, которая пила кофе в кафе

Врач видел дочку женщины, которая пила кофе в кафе

Сосед позвал маму девочки, которая пила кофе в кафе

Сосед позвал дочку женщины, которая пила кофе в кафе

A doctor saw/A neighbor called the mother of the girl/the daughter of the woman that was drinking coffee in a café.

6

Врач видел маму девочки, которая пила молоко в кафе

Врач видел дочку женщины, которая пила молоко в кафе

Сосед позвал маму девочки, которая пила молоко в кафе

Сосед позвал дочку женщины, которая пила молоко в кафе

A doctor saw/A neighbor called the mother of the girl/the daughter of the woman that was drinking milk in a café

7

Виктор видел внучку женщины, котораяразговаривала с соседями во дворе

Виктор видел бабушку девочки, котораяразговаривала с соседями во дворе

Врач остановил внучку женщины, котораяразговаривала с соседями во дворе

Врач остановил бабушку девочки, котораяразговаривала с соседями во дворе

Victor saw/A doctor stopped the granddaughter of the woman/the grandmother of the girl that talked to the neighbors in the yard.

8

Виктор видел внучку женщины, которая играла с котенком во дворе

Виктор видел бабушку девочки, которая играла с котенком во дворе

Врач остановил внучку женщины, которая играла с котенком во дворе

Врач остановил бабушку девочки, которая играла с котенком во дворе

Victor saw/A doctor stopped the granddaughter of the woman/the grandmother of the girl that played with a kitten in the yard

9

Учитель видел тетю девочки, которая читала книгу за столом.

Учитель видел племянницу женщины, которая читала книгу за столом

Директор перебил тетю девочки, которая читала книгу за столом

Директор перебил племянницу женщины, которая читала книгу за столом

A teacher saw/A director interrupted the aunt of the girl/the niece of the woman that was reading a book at the table

10

Директор видел дядю мальчика, которыйсмотрел мультфильм на телефоне

Директор видел племянника мужчины, которыйсмотрел мультфильм на телефоне

Учитель перебил дядю мальчика, который которыйсмотрел мультфильм на телефоне

Учитель перебил племянника мужчины, который которыйсмотрел мультфильм на телефоне

A director saw/A teacher interrupted the uncle of the boy/the nephew of the man that was watching a cartoon on the phone.

Distractors (Russian distractors were exact translations of the English ones)

Here comes our neighbor that walks with his wife every day.

I saw the director that walks with his wife every day.

Here comes the man whose wife runs in the park every morning.

I see the director that is walking with his wife.

Here comes the woman that sings on the balcony in the morning.

I saw the woman that sings on the balcony in the morning.

I can hear a woman that is singing on the balcony.

Let us call the woman that is singing on the balcony.

Here comes the man that loves talking about soccer.

I see the man that is talking about soccer.

The mother of the girl often goes to the park that opened a month ago.

I like the park that opened a month ago.

The wife of the politician likes the park that opened a month ago.

There is a nice alley in the park that opened a month ago.

Yesterday the mother of the boy went to the park that just opened.

They will play at the stadium that opened last week.

My mother liked the flowers that dad brought yesterday.

I often go to the coffee-shop that is nearby.

He is still drinking the coffee that I brought.

Everybody likes the movie that won the prize.

The man that is walking with his wife is my director.

The woman that is reading in the park has a sister.

The girl that is playing with a puppy lives in our building.

The woman that is buying flowers is my teacher.

The man that is buying flowers on the corner has a nice car.

The children that are riding bikes are my nephews.

The boy that is running in the yard knows my nephew.

The man that is carrying a boy is his father.

The woman that is talking about cosmetics is my neighbor.

The man that is talking about soccer is a famous sportsman.

I can hear the neighbor that is talking on Skype.

I can see a woman that is talking about Russia on the phone.

I have never heard of a game that you can play on Skype.

This is the boy that always plays games on Skype.

This is the boy that always wins when he plays computer games.

I do not remember the game that we played.

The game that we played was very interesting.

She told me about the game that you were going to play.

I cannot think of any movie that we can watch together with your family.

I liked the movie that we watched last time in the cinema nearby.

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